MINERS' NYSTAGMUS

SNELL

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AND ITS RELATION TO

POSITION AT WORK

AND THE

MANNER OF ILLUMINATION.

BY

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PREFACE.

The subject of which this volume treats has, especially recently, excited considerable interest in the Medical profession as well as in the Mining community. My connection with it is of old standing. My first communication on Miners' Nystagmus was written as long ago as 1875; and after reading a paper dealing with it before the Ophthalmological Society, in 1884, I wrote in the pages of the *British Medical Journal* a letter, in which I earnestly solicited information from medical men attached to coal pits, and from others who might be interested in the affection, which would tend to elicit the truth, whether it supported my observations or not. I concluded by saying: "My desire for facts is not merely to support the views I have expressed, but to arrive at the truth."

This inquiry was not fruitful in bringing the information wished for, but the spirit expressed in the above quoted remarks, has been that which has guided my subsequent investigations. I have availed myself of every opportunity that presented itself, to gather information which would aid in elucidating this, to me, most interesting malady. I have investigated and endeavoured to test the correctness of opinions which have been expressed against the views I have been known to hold, often at much expenditure of time and trouble, and frequently

to find such opinions not based on or supported by ascertained facts. This question has indeed been fruitful in producing statements which have been merely opinions. The result of all my investigations has been to corroborate in the fullest manner, the broad and essential conclusions which I have previously published; and has been such as to give me the conviction, that the cause of Miners' Nystagmus is as clearly set forth as almost any problem in the etiology of disease in medicine or surgery.

It is interesting to note that those who have most fully studied this malady in different countries, have arrived at almost similar conclusions. Dr. Dransart remarks on this feature in his recent letter to the British Medical Journal.* He says "Thus Nieden in Germany, Snell in England, and I in France, who are known to be much acquainted with Miners' Nystagmus—we have all three the same statements on this interesting disease."

Dr. Dransart and myself appear to have become interested in this disease, and to have begun our investigations about the same time. Independently of each other our conclusions have been the same; and it is only recently that any communications have passed between us on a subject in which we have both such a keen interest. My thanks are due to him for kindly supplying me with many facts as to the work of the miner in France; for forwarding me a naked lamp such as is used in that country, and moreover, for permitting me to use his photographs.

*Appendix, page 132.

Care has been taken to ensure as far as possible accuracy of the statements made in this volume. The whole of the text has been revised with great kindness by mine experts; and while this testifies to the general correctness of the technical portions referring to mining, I may say that as regards those dealing with Nystagmus, the statements made, with hardly an exception, have been personally verified by myself.

It is my pleasure to acknowledge the ready and valuable help that has been rendered me by all classes of the Mining community. One of the pleasantest features of the most recent—I regret it is so recent—portion of my investigations, is the friendship which it has enabled me to form with Mr. A. H. Stokes, H.M. Inspector of Mines for the Midland District. My thanks are due to him for valuable help as to the working of mines in his district. Mr. Pinching, H.M. Inspector for the Devon and Cornwall (metalliferous) District, was good enough to accompany me on my visit to a Cornish mine, and gave me information as to the mines in those parts. My thanks are also due for assistance to several others in obtaining information in different parts of the country, and I would mention that Mr. C. E. Rhodes, of the Aldwarke Collieries, and well known for his work in connection with the labours of the Royal Commission on Accidents in Mines has aided me in some parts. Mr. G. Blake Walker, of the Tankersley Collieries, has also rendered me valuable assistance, and, moreover, my thanks are due to him for not only readily giving me permission to use the engravings which had illustrated a paper of

his in the *English Illustrated Magazine*, but for kindly obtaining the consent also of the lady artist. To Messrs. Macmillan I am indebted for placing the blocks of the engravings at my disposal.

It is a pleasure to acknowledge the very great assistance received at the hands of the miners themselves. Many of them have been patients and many have not. Their numbers have been very large, and it is impossible to mention them by name. One only I refer to; he is no longer among the living; the late John Wyatt initiated me into the mysteries of underground pit life. He was a man of sterling character, so much indeed, that though a working miner, he had been Chairman of the School Board of his district.

I must acknowledge the kind way in which the Rev. H. L. Deering and Mr. A. Sopwith, M.E., have placed their series of photographs, taken in the mine with flash light and the electric light, at my disposal.

I should mention my indebtedness to Dr. Cocking for his kind assistance as the proof sheets were passing through the press.

Should any reader be willing to communicate any facts bearing on the subjects discussed in these pages, the writer would be pleased to receive them.

SIMEON SNELL.

February, 1892.

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CHAPTER I.

CHARACTERISTICS AND SYMPTOMS OF MINERS' NYSTAGMUS.

INTRODUCTORY.

THE earliest recorded notice of Miners' Nystagmus appears to be in a paper by Decondé in 1861, dealing with Nystagmus generally, and in which he refers to two cases occurring in miners, which had come under his observation. This paper was published in the Archives of the Belgian Academy of Medicine. Decondé thought there were reasons for believing that alcoholic excess and anæmia were the causes at work in occasioning the disorder. Since this time the subject has interested a considerable number of investigators; especially was this the case during the earlier years on the Continent. Many of the suppositions set forth by these different observers have in course of time been shown to be erroneous, and need not be further mentioned. On the other hand, the excellent work of Dransart, Nieden, and others, will be copiously referred to in the course of these pages.

My own connection with, and interest in the subject of Miners' Nystagmus dates back a considerable time. As long ago as 1875 I placed on record the fact, not previously noticed

it is thought, of the association of Nystagmus with miners engaged in a particular kind of work in the coal pit. Whilst much has been done on the Continent by distinguished oculists, as has already been mentioned, there has not been much attempt made outside my own work, to treat the subject in a wide and systematic manner in our own country. Many communications have from time to time been contributed to the Medical papers, and in this way without doubt a knowledge of the disorder and its essential characteristics has become established. Much, however, that has at various times appeared has been rather the expression of the opinions of the writers than the record of facts ascertained by diligent investigation into the circumstances surrounding the association of this affection with the toilers in coal mines.

The subject is by no means a simple one, and it is very essential for its proper elucidation that facts, well observed, should be recorded. It is intended in these pages to present the results of a long investigation into this affection of miners, and to give, what it is believed will be thought to be, abundant evidence for the statements which will be made, and for the opinions expressed.

The views held by me as to the prime cause of Miners' Nystagmus being the peculiar position assumed by a proportion of colliers at their work, have been for many years before the medical profession. Later researches have substantiated in the fullest manner those already published. Inquiry has been made in every direction that presented itself, and both inside and outside my own immediate practice, information has been sought for, whether it supported or not the opinions previously published.

Far from being a simple question, it is on the contrary, a complex one and beset with difficulties. For the proper understanding of it a knowledge of the working of a coal mine is almost necessary. It may be further safely asserted, that for

the complete investigation of the subject, an intimate acquaintance with the internal working of a pit, and of the different ways the various employés underground are engaged, is essential. This will be recognised by what follows, and it will be also shown how a knowledge thus obtained is often really necessary for the satisfactory investigation of many cases. With a view to obtaining the kind of knowledge spoken of, the assistance of Government Mine Inspectors, Colliery Managers, and other officials has been sought, as well as the kindly help of many colliers themselves. Further than this, I have been down into the pits, and seen the men at their work, and have by all these means become tolerably familiar with the interior of a mine, and the various kinds of work in which the miners are engaged. My observations have not been confined to one part of the country only.

SYMPTOMS.

A miner suffering from Nystagmus will complain of objects on which he fixes his gaze apparently moving, generally in a circle, and thus he will mention that the "lamps" appear to dance in the pit, or the gas lights when above ground. He will also suffer from giddiness in varying degrees; in severe cases he may stumble about the workings, and be not only unable to continue his work, but be compelled to leave the pit. Headache is also by no means infrequently complained of. The eyeballs will be noticed to oscillate, often with great rapidity, the frequency varying considerably; the movements may be 60 to 100 or more in a minute. They usually are of a to and fro, as well as of a rotatory character. The rotatory are seldom, if ever absent, but the horizontal and vertical movements may be more or less pronounced. In the case of a man who had lost an eye through purulent ophthalmia in infancy, the oscillatory movements were well marked in the good eye, but if my memory serves me correctly, motions were also visible in the small stump representing the destroyed organ.

In a recent case the motions were also noticeable in the shrunken remains of an eyeball. It has been asserted that occasionally Nystagmus has been met with in one eye only. My belief is, that if this be the case, it must be extremely rare. There is, however, occasionally a varying markedness in the motions in the two eyes. An instance recently, in which it had been asserted that the Nystagmus existed in one eye only, was after very close examination found also to be present in a less degree in the other. This was ascertained by keeping a steady view of the optic disc with the ophthalmoscope, when after a little time, the motions of the papilla became apparent.

The ocular movements are brought to a standstill, even in severe cases by looking *below* the horizontal line. And not only is this the case, but a sense of comfort is experienced.* A man suffering from Nystagmus recognises this, and places his gaze in this direction. Relief at work is sought by this device. There is frequently with these patients a peculiar carriage of the head, it being thrown back, so as to enable the greatest range of vision whilst the gaze is directed downwards. Besides this, a patient suffering from Nystagmus may be observed as he approaches you to have his head inclined on one side, and this in cases where the severity of the affection hardly calls for the compensating position just mentioned. The tilting of the head is a habit acquired, doubtless, as a result of the flexed position in which it is held by the miner when at work.

The ocular movements are increased, or in other cases rendered evident, by raising the eyes *above* the horizontal line. Any motions of the head bringing this about will make the oscillations more apparent. Lowering the head and raising it rapidly —simply casting the gaze upwards, and especially

* Dr. J. A. Smith (*Brit. Med. Journ.* 1891, vol. i. p. 476), mentions a case of a miner who when at work sought relief by rising (from holing) on to his knees. I have heard similar statements from patients.

obliquely upwards, either to the right or left, are all means of increasing their frequency. Placing the patient in the peculiar position in which he has to put himself at work is a means, not only of bringing about more marked movements, but also of occasioning often giddiness. The ocular motions will frequently be more distinct on looking to one side than the other ; for instance, on turning the eyes upwards and to the right, than when they are directed to the left, and *vice versâ*. Associated with the oscillations of the eyeballs will be in some cases quivering movements of the eyelids, of the head, or of the muscles of the face, head, or neck. In a few cases the quiverings of the upper eyelids are combined with a kind of incomplete ptosis. These points will be discussed in more detail in a subsequent chapter.

In the majority of cases that apply for medical relief the oscillations are at once evident, or readily become so, on directing the eyes obliquely upwards, or by the other tests just mentioned. There are other instances, however, in which the subjective symptoms of the lights dancing, and so on, are complained of, but in which the oscillations will only be detected by the most careful examination. These appear to be incipient, or observed in an early stage. Frequently, however, by pressing the hand on the head whilst the patient is directed to look upwards, or obliquely upwards, a vibratory impression will be noticed, and it seems very probable that if such cases were examined immediately after their leaving work, that the ocular movements would be more readily detected.

Further than this the other symptoms do not always bear a definite relation to the markedness of the oscillatory movements. It by no means infrequently occurs that colliers presenting themselves for some other affection, abrasion of the cornea for instance, or perhaps it may be in another department of the infirmary, are found to have the ocular movements distinct, but with the other symptoms usually associated with

Nystagmus, little pronounced. Inquiry will elicit that though, perhaps, dancing of objects has been noticed, but little discomfort has been experienced, and work has been hardly, if at all, interfered with.

Work at the coal seam will put into play the ocular oscillations ; at the end of a short time the sight will become clouded and indistinct ; the miner will still strike the coal though he does not properly see it. As Dransart puts it, it is more by habit, for the eyes do not direct the pick. If the miner persist at his work, he will suffer from headache and giddiness ; and when he stops because he can no longer see to continue his task, he will rest by turning the gaze downwards. Obtaining relief, he may resume work, when the same set of symptoms will reappear.

Associated with Nystagmus in some cases is an amount of night blindness. It may occur in colliers independently of Nystagmus. I have never seen the need of attributing as much importance to this condition as some have done, and this is said after extensive experience of colliers and their eye diseases. In my experience it is very rare for a miner to seek advice for this condition alone. Dransart, moreover, found the field of vision normal in all cases of Nystagmus, except in one miner who was the subject of true nyctalopia or pigmentary retinitis. The night blindness is dependent on retinal torpor, and is a functional disorder.

Errors of refraction are met with not infrequently ; myopia, hypermetropia or astigmatism are present in a proportion of the cases. Some time since I examined a fair number of cases as to their refraction, and could not find that anomalies in this way bore any relation to the Nystagmus. High or low degrees of hypermetropia or myopia were sometimes present, and astigmatism was met with, chiefly, I think, myopic. Dransart, in the article just quoted, says that he found nine-tenths of the cases emmetropic ; in others there was hypermetropia, myopia or anisometropia.

Visual acuity is generally normal, and would be found to be so more frequently, if the oscillations did not interfere with accurate testing. According to Dransart the sense of colour is always normal.

It is interesting to note that a tendency almost appears to prevail in some families to the development of Nystagmus. Thus three brothers working in a candle-lighted pit were sufferers; two brothers at least twice have been met with, and a father and son more than once.

An outbreak of Nystagmus appears sometimes to be determined by some illness—any affection by reducing tone can act in this way—tonsillitis in one case, influenza in another, and blows on the head in others, have seemed to have had such an effect.

SOME ALLEGED CAUSES.

Some of the causes assigned for the production of Nystagmus, need only occupy our attention very briefly. Formerly it was considered as occasioned by the deleterious gases disengaged in coal pits. Such an idea is, however, now obsolete, and if it were not so, it would be sufficient to refer to the improved ventilation of mines of the present day, whereby the existence of such conditions has been practically abolished. Dr. Nasmyth in his able report * on the air of coal mines, speaks of the air of twenty years ago as being very bad, when properly directed currents of ventilation were almost unknown. "Nowadays" he finds as the result of his investigations that "the air is generally good; ventilation is efficiently carried out." He moreover states "that the conditions connected with the miner's occupation are as favourable to health as those in the occupation of any other workman." With this statement, as it refers to workers in some of our large towns, less fault can be found, than as it relates to out-door workers breathing pure air, and living in the sun-

* *Brit. Med. Journ.*, 1888, vol. ii. p. 222.

light; for with these latter the miners' life underground hardly, I think, compares so favourably.

It is interesting, however, to notice that as regards mortality the miner does not stand in such an unfortunate position as has sometimes been thought. Dr. W. Ogle, Superintendent of Statistics, Registrar General's office, brought this fact out in a paper read before the recent International Congress on Hygiene (1891). He says, "seeing the conditions under which coal miners work in a hot and dust-laden atmosphere, and their terrible liability to fatal accident, it might naturally be expected that their death rate would be excessively high. As a matter of fact this is far from being the case; even when fatal accident is included, their death rate is by no means an excessively high one; and putting accident aside the death rate from disease alone is exceptionally low, being almost exactly the same as that of agricultural labourers."

My friend the late Mr. Oglesby * described the affection as partaking of an epileptiform character, and Mr. Jeaffreson† of Newcastle has also endeavoured to associate Nystagmus with a central lesion. I am not aware, however, that such opinions receive support at the present time. My own observations in a large number of cases have shown a singular absence of the symptoms we are accustomed to associate with brain or even spinal trouble. I shall content myself, therefore, with repeating what I said in my paper before the Ophthalmological Society in 1884. "I have seen nothing to lead to a supposition that the affection was dependent on central disease. I have never seen a case that raised such a question. There has never been any optic neuritis, and the nervous symptoms when present, such as vertigo, are readily enough explained by the ocular conditions."

There remain for consideration two different sets of opinions.

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* Ophthalmological Society's Transactions, vol. ii, p. 273.

† *British Medical Journal* 1887, vol. ii, p. 109.

It is claimed on the one hand, that the cause of the affection is to be sought in the employment of "safety lamps," and the imperfect illumination of the mine. On the other hand is the theory, for which I have contended in my published papers, that Miners' Nystagmus has for its prime cause the peculiar position which the miner is obliged to assume at his work. It is of the relation that position and illumination bear to the production of Nystagmus, that this volume will mostly treat.

Chapter II.

MANNER OF ILLUMINATION AND THE SAFETY LAMP THEORY.

SAFETY LAMPS.

The times have changed since the introduction of the original Davy Lamp (*Fig.* 1),* with its cylinder of wire gauze encircling a very poor light. Its exterior light was considerably below one-fifth of the illuminating power of a standard candle. Improvements were made by Dr. Clanny (*Fig.* 2), who introduced the use of a

* The following description may be given of some of the varieties of safety lamps :—

Davy.—In this lamp the flame is surrounded by a cylinder of fine wire gauze—which materially diminishes the illuminating power of the lamp.

Clanny.—The upper portion of this lamp is a wire gauze cylinder similar to that used for a Davy lamp, but the lower portion is a cylinder of glass which surrounds the flame, and by this arrangement a far better light is obtained than when surrounded with wire gauze as in the Davy lamp.

Clanny (with bonnet).—This is an ordinary Clanny lamp, but the gauze portion above the top of the glass cylinder is encased in a sheet-iron bonnet for the purpose of protecting the lamp in strong currents and also from injury to the gauze.

Marsaut.—A lamp of the Clanny type, with two cylindrical gauzes above the glass cylinder instead of one as in the Clanny lamp. These gauze caps fit together closely at their bases on the top of the glass and gradually separate from one another as they proceed upwards. In some cases a triple gauze is used. In all cases the gauze is protected by a bonnet of sheet-iron. The air is admitted through a number of large holes near the lower end of the bonnet, and the products of combustion escape through a series of large apertures at the top of the bonnet, just above the wire gauze cap.

Mueseler.—This is a lamp of the Clanny type, but with a conical metal chimney supported by a horizontal gauze diaphragm fixed inside the wire gauze cap. The bottom of the chimney extends below the upper portion of the glass cylinder encircling the flame, and the top of the chimney reaches within a short distance of the top of the gauze cap. Mueseler lamps are protected by bonnets of sheet-iron round the gauze portion of the lamp.

short glass cylinder, in place of the lower part of the gauze, and lamps of this description have been employed for many years. Further improvements in the illuminating powers of lamps have also taken place. The Royal Commission on Accidents in Mines tested no less than 250 safety lamps, and in their final report made in 1886 they selected four lamps (*Fig.* 3) as deserving of special mention, viz. the Gray, Marsaut, bonneted Mueseler, and the E. Thomas No. 7. The Marsaut Safety lamp (*Fig.* 4) which is employed in considerable numbers in the mines of the Midland Counties,

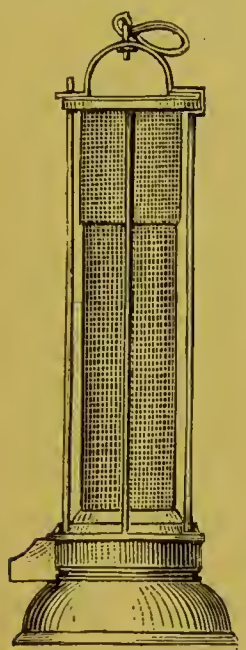

Fig. 1.
DAVY LAMP.

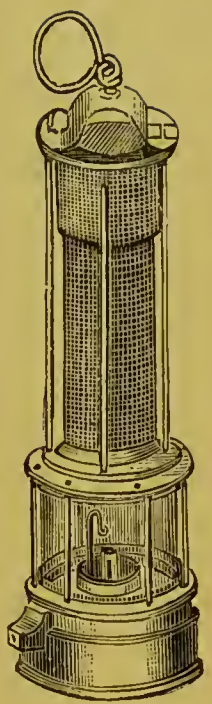

Fig. 2.
CLANNY LAMP.

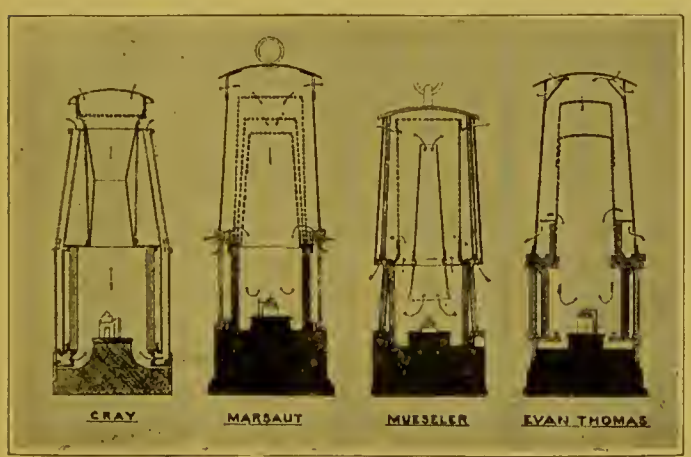

Fig. 3.
THE FOUR LAMPS SELECTED BY THE ROYAL COMMISSION ON ACCIDENTS IN MINES, 1886.

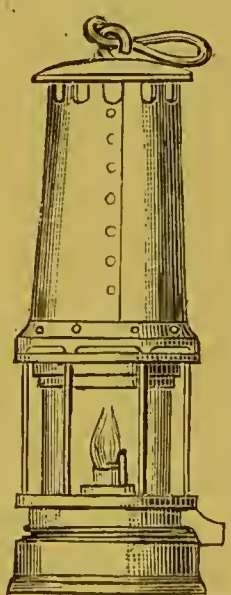

Fig. 4.
MARSAUT LAMP.

is thus spoken of: "M. Marsaut's lamps have also the advantage of yielding a good light. With two gauzes the illuminating power was

found to be two-thirds that of a standard candle"; and in another place—"Thus in one experiment (with the Marsaut two gauze lamp), the lamp flame being left untouched after being lighted and remaining in a still atmosphere, the height of the flame continued constant for two hours, and fell from 1 inch to 0·7 inch in a further period of five hours; in a second experiment the height of the flame fell 0·1 inch (from 0·9 to 0·8) in two hours and 0·3 within a further period of five hours as in the former experiment. After burning for seven hours it was trimmed with the pricker, and then maintained an uniform height for two hours, when it was extinguished."

The dusty atmosphere of the coal mine will no doubt diminish somewhat the light-giving power of a safety lamp. But such a lamp as just described gives three and a half times the light of a Davy Lamp.

In the modern safety lamp the gauze portion is bonneted by a sheet-iron casing, which not only protects it from strong currents of air, but causes the flame to burn with a steadier and more uniform light.

I am informed by Mr. A. H. Stokes, H.M. Inspector of Mines in charge of the Midland District, that there are more than 53,000 persons employed underground in his district, and over 33,000 safety lamps are in daily use. Of this number 17,500 would be of the Marsaut type (*Fig.* 4). The whole of the lamps may be described as consisting of a light surrounded by an ordinary glass cylinder or Clanny glass, the difference being in the upper or gauze part and the mode of feeding the lamp with air.

The best of these lamps is hardly yet equal in illuminating power to the tallow candle ordinarily used in mines, but as a miner, who had some years back worked with a Davy lamp, pithily expressed himself by saying, in speaking of a modern safety lamp, "It is day-light to the old one."

The alternative to the use of Safety lamps, excluding the

Electric Light lamps, in a coal pit is the employment of naked lights. In some places open oil lamps called "torches" are in use, but when Safety lamps are not employed the illumination is generally effected by candles. For ordinary work these tallow candles are from sixteen to twenty to the pound. In the Derbyshire Collieries the candles mostly used, called " bluelights," are 18 to the pound ; are thin and long, and with a thick wick. The candle is fixed in soft clay, which makes it easy of attachment to the place where it best throws a light on the work. The influence of a strong current of air necessitates the light being shielded, either by a prop, or other protection, and the quantity of diffused light is thereby materially diminished.

The miner naturally prefers a candle to a safety lamp. I have seen them both in use in the mine. He can place the candle where it gives the best light, and if it goes out, he can relight it. It is different with safety lamps. They cannot be placed so near the point of attack on the coal face, but must be clear of the swing of the pick.

In considering the illuminating power of a safety lamp the comparison is made with that of a standard candle. This is not perhaps always remembered, but it is necessary to recollect, that the comparison is not with any given kind of candle used by the miner. In the absence of any reliable information as to the light emitted by miners' candles, a friend very kindly obtained an analysis for me, made by a well known gas engineer, Mr. C. E. Jones, Engineer to the Chesterfield Water Works and Gas Light Company.

The report runs as follows :—

"Owing to the taper form and varying rate of burning, testing tallow candles accurately with a view of getting data, is a tedious not to say an almost impossible task. From this you will infer that I have not exhausted the subject. As to candles 18 to the lb., the light emitted varied from 36·80 to 73·60 per cent. of the standard candle. Candles 16 to the lb.,

these show a variation of 61·53 to 77·24 per cent. of the light emitted by the standard. It is, however, possible after burning the thicker end of a 16 to the lb., by snuffing and nursing it, to get a light exceeding that of the "standard," but I suppose that this would be seldom done in the mine. The candles were cut in two in the middle, and lighted at the severed portions, no two burning with anything like regularity or similarity."

Reviewing the statement made in this report, it would appear fair to state the average thus:—

Standard candle - -	100
Tallow candles 16 to the lb. -	69
„ „ 18 to the lb. -	55

ALLEGED INCREASE OF NYSTAGMUS.

It has been asserted that Nystagmus has become a more common affection now than it was formerly. I am not aware of any statistical information really bearing on this subject. Undoubtedly in my own practice I see cases with greater frequency now, than I did some years back. I have, however, been known to have devoted special attention to the subject, and patients have come to me from a more extended area, but I hardly think they form any very undue proportion to the increased number of patients, with other affections seen by me than was the case, say ten years ago. What, however, has happened is, that a knowledge of the malady has become more diffused among surgeons practising in colliery districts, and stimulated especially recently by controversy, they have recognised and become more familiar with an affection which before had but little attracted their attention. In this way some of my friends, who were inclined at first to dispute the occurrence of Nystagmus at all in the workers with naked lights, on investigation have admitted the fact of its existence.

That the disease is by no means a new one is easily shown. For about twenty years I have myself been familiar with it, and

on coming to Sheffield in 1874, I found my friend, the late Mr. Gillott, who had practised for many years as an Ophthalmic surgeon, quite conversant with the affection. From what he told me he must have seen cases for many years previous to the time I mention, I should say upwards of twenty years. It is, however, interesting to observe, respecting the prevalence of Nystagmus, the very largely increased number of men who are now employed in coal mines. The number of persons employed *underground* in 1869 was 300,000; in 1879, 385,179; whilst in 1890 it reached 506,812. For the year 1869 the number is estimated, but for the years 1879 and 1890 the number is from actual returns published by H.M. Inspectors of Mines. Again, in the Yorkshire District (No. 5 Inspector's District) the number employed underground in 1880 was 48,742, and in 1890 the number of persons employed was 63,765. In the South Wales District (No. 13) the number employed underground in 1888 was 57,105, and in 1890 it had risen to 69,741, an increase of 12,636. These are facts which must of themselves, in whatever direction the cause of Nystagmus be sought, give opportunity for the occurrence of more than a third more men afflicted with the malady than was the case twenty years ago, simply by the additional number employed at collieries underground. Further, the advocates of the safety lamp theory, when they suggest an increase of Nystagmus, appear to overlook the important improvements brought about in recent years in the illuminating power of protected lights. It is clear, also, that whether Nystagmus has increased or not, if even it still exists as much as formerly, in spite of the improved lighting afforded by modern safety lamps, it is a strong argument against their views as to the causation of the malady.

HOW DO SAFETY LAMPS OCCASION NYSTAGMUS?

No definite explanation of the way in which the safety lamps bring about the Nystagmus has yet been forthcoming. The symptoms present are of such a character, that without bringing

in the fatigue element, no such attempt could be made, and therefore it is supposed that extra visual strain is occasioned by the imperfect illumination. Considering that we have to deal with definite groups of muscles that are affected, such a supposition does not afford much help in accounting for the occurrence of the Nystagmus. This volume deals more with facts which will, it is believed, show that the question of illumination cannot hold the prime place in causing Miners' Nystagmus. It is not proposed, therefore, to discuss now the pathology of the affection. It will suffice to observe regarding the association of retinal torpor that Nystagmus is not met with in true nyctalopes, and, also, that in grouping the malady under consideration with the Nystagmus met with in children, the subjects of leucomatous corneæ or cataractous lenses, the difference between the two is often lost sight of. The favourable prognosis in the Nystagmus of miners must also be remembered. In Miners' Nystagmus the symptoms are of a definite kind, and, to mention no others, prominent among these is the complaint of the objects dancing, usually in a circle, in front of the patient. Now it is generally recognised that patients the subjects of congenital Nystagmus,* or of that existing from infancy, are neither conscious of the movements, nor are there apparent movements of objects. A theory has indeed yet to be formulated, which will account for the symptoms found in Nystagmic (miners) patients.

If imperfect illumination were the cause of the disorder, all the workers in the pit should be equally affected, and in the same way all the ocular muscles should be implicated. It will be shown further on, that all workers are not equally prone to Nystagmus, nor is it an affection equally involving all the muscles of the eyeball.

In many parts a serious prejudice exists amongst miners to "Safety Lamps." They are disposed to ascribe many ills to their use, and a wide spread feeling prevails as to the injurious

* Gowers : "Diseases of Nervous System," vol. ii, p. 194.

influence which the protected lights exert over their eyesight. Ever since I have known anything of Nystagmus, I have been equally familiar with the cause to which the miners often attribute their affliction. If such opinions constantly re-iterated could have overborne the facts learnt by investigation, I should long ago have come to regard the "Safety lamp" as the prime cause of the malady. It has been asserted even by medical men that attention must be paid to this feeling on the part of the miners themselves; and it may be at once granted that no one desirous of arriving at a correct conclusion could shut out from his consideration such an expression of opinion. What is important, however, to bear in mind, is not the beliefs of the mining community, but the actual facts surrounding the question. Popular opinion by no means infrequently runs counter to what medical men hold to be essential truths. In this case, in my opinion, the facts to be hereafter brought forward are directly opposed to the acceptance of the employment of safety lamps, or in other words the manner of illumination, as bearing any other than a secondary place in the causation of Nystagmus.

The persistent manner in which some miners, at the outset at all events, adhere to their statements that it is "all the lamps" that is occasioning their disorder, often renders the investigation of cases difficult, and considerable experience is needed to arrive at a correct conclusion.

Frequently, the miner's opinion as to the injurious influence of the safety lamp, is founded on the apparent "dancing" of the lamps, which the peculiar oscillations of eyeballs occasion, but which, as he will admit, is not confined to lights in the pit, but is noticed also above ground. A miner engaged with naked lights and suffering from Nystagmus makes a similar complaint as to his lights dancing. It is seldom, however, that in the end, a miner fails to be convinced that his opinion is not strictly correct, for his experience will teach him that whilst all the workers underground use the same type of lamp, it is those

engaged in coal-getting who are particularly prone to the affection, and he will not be slow in perceiving, that there must be something in the mode of employment of these men that acts more potently in developing the disorder. There is, in my opinion, recently a greater tendency among miners themselves to accept these conclusions.

THE ALLEGED BENEFIT OF A CHANGE FROM A SAFETY LAMP TO A CANDLE LIGHTED PIT.

It has been frequently alleged by the advocates of the "safety lamp theory," that men suffering from Nystagmus become improved when they leave a pit where protected lights are used and obtain employment in a mine worked by naked lights. In view, however, of the undoubted occurrence of Nystagmus in candle lighted pits, in men indeed who have never used a safety lamp, as well as in those working in good circumstances as regards illumination, such a statement ceases to be of moment. These facts will be brought out further on, and allusion will also be made to cases in which the change above indicated, from safety lamps to candles, has been succeeded by an aggravation rather than an improvement in symptoms, and others have failed in receiving benefit. For the present, as the statement is often repeated, it may be well to briefly analyze it. I am not aware of any cases which have been recorded in support of the allegation. It has been merely an expression of opinion; but even if there were such cases, we should still be far from being able to associate the benefit with the change only of the illuminant. The essential point to be elicited is whether or not the mode of work has been identical under the altered illumination, to that pursued when using the safety lamp. By investigating this point I have, in cases of alleged benefit, which I have been able to examine thoroughly, satisfied myself that such improvement was associated with an altered description of work, and of a kind which I should have expected, as will be described when

considering treatment, to be beneficial, even if the patient had continued using protected lights.

Last year (1890) a collier (Case 83), himself a bad example of Nystagmus occurring under the usual conditions, informed me that his brother had also suffered; but, having gone to work in a candle lighted pit, he had "got better." They lived some miles away, but I was successful in obtaining a visit from the brother. I found on examination that Nystagmus was absent, as indeed was also the usual train of symptoms ; nor was there any clear history of their having been present. His complaint had never been more than trivial, and at no time had he ceased work in consequence of it. Inquiry further showed that whilst he was employed as a stallman, doing "holing"* and other work as a coal-getter when using "safety lamps," now in the candle pit, he still worked as a coal-getter, but that such holing was not required, and the two brothers admitted that the work now engaged in was less irksome than that which was formerly done.

It was determined to investigate this case, and to observe if possible the actual conditions under which he was now working. Accordingly, in August, 1890, having obtained permission from the manager, I visited this pit, which was situated near Chesterfield. It was a "day-hole" or "incline," and instead of descending by a shaft, one walked down an incline from the surface.

The distance to reach the coal face was about 90 yards and the height of the road traversed was 4 feet; at some places it was necessary to creep under 3 ft. 6 in. To a man standing 5 ft. 9 in. this alone gave evidence of some of the discomforts under which a collier pursues his avocation. Provided with candles we traversed this road, and found our man engaged at the coal face. As expected, his work, like that of those around him, was much

* Holing is the miners' term for cutting or excavating under the seam of coal preparatory to dislodging it from its bed. It will be fully described further on.

less irksome than bottom or top holing. He did his coal-getting crouched down on his haunches, and with head straight. I handled a pick and could have done so long enough without ocular discomfort, but the position, crouched down, was to me decidedly unpleasant. The visit occupied altogether about an hour, and bent down as I was nearly the whole of that time under four feet, on reaching the surface again I fully experienced some of the effects of unusual muscular exercise.

An instance like the one just related, serves to show that statements of miners with Nystagmus, becoming improved in changing from a safety lamp to a candle lighted pit, must be received with reserve, and that no such case can be accepted unless distinct evidence is forthcoming of a continuance of employment similar to that followed when using safety lamps. Evidence further on will be given, however, of cases which became worse or which failed to be benefited on obtaining work in candle lighted pits, and above all of the occurrence of Nystagmus in men who had never worked with protected lights.

Some of my friends indeed who are inclined to attribute a prominent place in the causation of Nystagmus to the use of safety lamps, have furnished me with details of cases becoming worse in changing to a candle lighted pit.

NYSTAGMUS IN MINERS WORKING WITH CANDLES.

We come now to deal with the presence of Nystagmus in miners using candles. The establishment of the existence of the disorder under these circumstances is an argument of the highest importance against the safety lamp theory, because it will be seen at once that the cause which its supporters allege to be the main one, is absent. It is indeed fatal to such a theory, and those who aver that imperfect illumination is at least as prominent as any other cause, are reduced to the contention that after all the light afforded by the candle is an indifferent one. This latter view must, however, also in its turn give way, in the

face of the occurrence of Miners' Nystagmus under excellent conditions as to light, which will be presently mentioned.

In the tabulated series of cases will be found several in which Nystagmus occurred in those working with candles. The following is a very interesting example.

George H. (Case 100) came to the Sheffield General Infirmary on November 25th, 1890. He was suffering from Nystagmus with well marked and rapid oscillations, and he had been compelled to leave his work. His age was 38; he had been employed in coal pits for 24 years. At first he worked with candles, then for 14 years together he used safety lamps. For the last three and a half years he had been working at a colliery* near Sheffield where 80 or 90 men were employed. During this time (three and a half years) he had used candles and not safety lamps. His work in this pit has been in a seven-foot seam; he has been a coal-getter and he would, with others, to use his own words, "Drive a heading and get the coal down by "holing" three or four feet under." He has done no more holing in this pit than he had previously done when using safety lamps. He asserts very positively that when using "safety lamps" he experienced no discomfort with his eyes, and that it is lately† during the time he has been working with candles that symptoms have developed. He dates the earliest symptoms back to 15 or 18 months, but he had pursued his work until four days before coming under my

* I have evidence of others engaged at this colliery being afflicted with Nystagmus, and one miner, who has used candles for the last ten years, is under my care at the time of writing.

† Dransart says he can cite cases which lasted for nine years, although the subjects worked with naked lights. They worked in low galleries, which greatly, he says, encouraged muscular fatigue. He can besides this mention other cases in which Nystagmus supervened in miners working with naked lights when (like my case above) they had been exempt from the affection during work for five or six years in seams lighted by safety lamps. He adds, "The apparent contradiction which exists between these facts disappears when one takes into consideration, not only the illumination, but also the height of the seams."

care, when he was compelled to desist. There is then, in this case, no doubt about the Nystagmus developing during the time he used candles at his work. The man was shown at the Sheffield Medical Society in December, 1890, and has been seen also by several medical friends, some of whom were sceptical as to the occurrence of Nystagmus at all in "candle men."

In the neighbourhood of Sheffield, indeed I may say for several miles round, in what I may call the radius from which my cases are mostly drawn, safety lamps are very largely used. The pits in which candles are employed are in many cases small ones, and the number of colliers engaged in them is also small.* The number of cases therefore in men from candle pits is more proportionate to the total number reported than it might otherwise appear. I will only now refer to one other case, that of a young man who, after working with safety lamps, went to work at a pit where naked light lamps or, as they are called "torches," were employed. Three months later he sought my advice in consequence of Nystagmus and the characteristic dancing of objects.

I have, however, been able to obtain very material corroboration of the statements as to the existence, and indeed prevalence, of Nystagmus in candle lighted pits, and the manner in which the following facts came under my notice is not devoid of interest.

A medical friend was sceptical as to the occurrence at all of Nystagmus in miners using candles. He lived with pits so illuminated all around him, in which large numbers of men were employed. He did not remember having seen cases occurring amongst the men so engaged. Surgeons in colliery districts have frequently made similar assertions, but in this instance my friend determined to be on the look out, and he

* Inquiry from the best informed sources has satisfied me that candles are used by not more than 20 per cent. of the miners in the area from which my cases are chiefly drawn ; 80 per cent. or more use safety lamps.

has since stated that "there are several cases in candle lighted pits in this neighbourhood with which I am personally acquainted." He also informed me, that on inquiring of the manager of some of these mines, he found he was familiar with Nystagmus amongst the miners.

The first case from this district was S. H., aged 31.* He commenced to work in the pit at a very early age, being then what was called a "trapper," a boy who opens and shuts a door in a mine, but he also ran about, he says, supplying the men with candles. Since this time he has been in succession, a trammer, filler, holer and stall-man. In this latter work he has not only done holing, but he has got the coal down after it has been undercut, and has also had to do "timbering." It is important to note that he has worked in another pit, besides the one in which he is at present employed, but he had *never used safety lamps, but always candles.* The pit he worked in was a candle lighted pit; there were indeed two pits together, one hard, and the other soft coal, and candles were used in both. He had suffered from symptoms of Nystagmus for eighteen months, and he had been away from work a great deal on and off during the last twelve months. He was an intelligent man, and gave me most interesting information respecting the men at his pit. He seemed well acquainted with the disorder, and knew of several who suffered. He could easily get nine or ten together. He knew of five who were away from work at his pit then in consequence of Nystagmus, and the number employed underground at the mine was about 300. He had been off work himself for five weeks. Finally he promised to get these men together if I would pay a visit to see them. This I promised to do.

The Nystagmus in this case was rather peculiar; it was less

* The series of cases which are here mentioned are tabulated in the Appendix under "Special Investigation of the Workers in Candle Lighted Pits at C." Case 116 onwards.

rotatory than usual, being more to and fro, and the apparent movements of objects corresponded to this. Further, at the first sight it seemed as if the oscillations were confined to the right eye. Careful examination satisfied me that though much more marked in this eye, movements of the left eye were also present. For instance, on watching the optic disc with the ophthalmoscope, motions of the papilla were evident. The right eye was also astigmatic, simple myopic (cyl. 3·5D=$\frac{6}{12}$), and the left was myopic (–1·25D=$\frac{6}{6}$). On the right cornea was a slight nebula; it was eccentric, and was the result of one of those abrasions to which every miner is subject.

My visit was made in company with Mr. Clyde Hayes, and another medical friend. Our miner had only had notice the day before of our visit, but notwithstanding the shortness of the time, he had succeeded in getting together twelve men for our inspection, a fact clearly showing his familiarity with the affection, and his knowledge of those who were afflicted by it. The acquaintance indeed possessed by these candle men with the malady and those suffering from it, I have not found equalled in my large experience among the workers with safety lamps.

Including himself there were six men from his pit (hard coal) who were at that time off work. Two of these were his own brothers; one had been unable to work for fourteen weeks, and the other had come out of the pit on that day. The fact as to the absence of the use of safety lamps in these men during the time they had been engaged in a pit, was most interesting. The Nystagmus was mostly well marked. One man had never used safety lamps; another had only worked with them for six months, five years ago. A third had only used "lamps" for twelve months, seven years ago; he had worked in a coal mine 39 years. Another * had been engaged in a pit for 46 years, and except for an occasional day when there was gas

* He reported that his son, also working in a candle lighted pit, was a sufferer.

about, he had never used safety lamps. The same remark applies to another who had worked for 37 years in a pit, and the sixth had never used "safeties" at all. With one exception, all these men were stall-men.

It was ascertained that in this particular pit out of 350 employed underground 150 were stall-men. I wish to draw particular attention to the relatively large number of these men who were off work at the same time for this affection, viz., five out of the 150 stall-men. There is a manifest difference in being merely the subject of Nystagmus, and being rendered unfit by it for a continuance of work. The other man though not a stall-man, a loader, did holing and similar work. These cases are dealt with in the tabulated series.

The six other cases brought together for our examination were as follows. Three were employed at the soft coal-pit. One* had worked in a pit 14 years, had always used candles except two years ago, when he employed safety lamps for three months, and also, for an occasional day, if there was gas about the workings; he had to leave work five weeks ago. Another had worked in a pit for 21 years, and had never been obliged to leave his work; he had always used candles, except for eighteen months when he worked with "lamps." This period ceased eighteen months ago, and it was clearly shown that it was not until he had returned to the use of candles for three months that he felt any discomfort with his eyes. The third had suffered for many years according to his account; he had just been off work for three weeks, but had returned to the pit a week before; he had worked in a coal mine for 32 years. He appeared to have employed safety lamps, at different times, for about five years altogether out of this period, but for the last ten years he had used candles regularly, except for eighteen months with lamps two years ago. He was a very decided partisan of the "lamp theory," and

* His father was reported to be a sufferer also, and he worked in a candle pit.

rather resented inquiries as to the possibility of his eye trouble beginning when using candles. Under which illuminant the affection began is not clear, and may be regarded as doubtful. One point, however, is definite and distinct, that with the better light afforded by the naked candles he was no better, for he had just returned to work after an absence of three weeks. Another man worked at first with naked lights, paraffin lamps or torches; then for four years he used safety lamps, and for the last fifteen months he had worked with candles. He was still engaged in the pit. The commencement of his trouble appeared to be when using the safety lamps. Another man was engaged in a safety lamp pit. I have mentioned these cases because they formed part of the twelve collected for me to examine, and my friend the miner had brought them, as he knew they suffered from Nystagmus. The twelfth case is most interesting, occurring in a "deputy," and will be referred to later on. He worked in the candle pit first mentioned, but in his duty of searching the workings for gas, etc., he employed a safety lamp.

I paid a subsequent visit to this locality in company with my friend, Dr. Cocking. I had hoped to have seen more cases, of the existence of which there was abundant evidence, and there was reason for believing that these men were acquainted in al with quite twenty cases among the miners in that locality, working with candles. Circumstances into which it is unnecessary to enter, prevented their appearance in the manner expected. Nearly all of the cases already mentioned were, however, examined a second time; some indeed were seen by me on three occasions. I learnt from one man that his father, working in a candle pit, suffered from Nystagmus, and from another that his son, engaged also with candles, was afflicted. Two additional cases were seen. One was a young man, aged about 24, who had been engaged in a coal mine for eleven years. He had worked with safety lamps up to a year ago, since which time he had used candles. His symptoms commenced about the time of his

changing from one kind of illuminant to the other, but he asserted that he had been getting worse since working with candles. The other man was a deputy, using a safety lamp in a candle lighted pit, for examining for gas, etc.

The information gained by this investigation is most valuable and important. Eleven cases were found amongst the workers in candle lighted pits, excluding the two deputies. In the case of one man who had previously used naked lights, open lamps or "torches," the affection appeared to begin when using safety lamps, and it continued whilst working with candles. In another, the symptoms began just as he was changing from safety lamps to candles, and had become worse whilst using the latter. Of the other nine, four had never used safety lamps at all, and the keenest advocate for the theory attributing the malady to their use, could in those other cases in which the use had been so little and so very occasional, hardly venture to suggest that they in any way owed their Nystagmus to this cause.

The correct mode of investigating these cases is to ascertain as near as possible which mode of lighting, safety lamps or candles, was being used when symptoms commenced. To exclude a worker with candles simply because he has before employed safety lamps is misleading, and could only be adopted to explain away the undoubted occurrence of cases of Nystagmus in candle lighted pits. A similar plan of treating Nystagmus found in the workers with safety lamps, would also exclude most of these cases, because the majority, at all events, in those that come before me, have at one time or another used candles, and the exclusion would be quite as reasonable in the one case as in the other. In the judgment of most it will, however, I think, be evident that the existence of such cases as have been described absolutely prevents the acceptance of the employment of safety lamps as the prime cause of the disorder, for they demonstrate clearly that Nystagmus does occur, and that frequently in circumstances in which such a cause is wanting.

As this volume is passing through the press, very similar experience has been gained respecting the miners employed in candle lighted pits* in another locality from that just mentioned, in closer proximity to Sheffield, though some little distance away.

J. W. S. (Case 107) came to me as a patient in October, 1891, suffering from Nystagmus. He had, he told me, consulted me several months ago for the same malady, and had returned to his work in the pit, but was now again compelled to relinquish his employment. He had *never used a safety lamp, but always candles.* He knew of several miners besides himself who were suffering, and who were employed at his pit, and an adjoining one, in which candles also were used. He got together eight cases, which were examined by Dr. Rhodes, House Surgeon at the Sheffield General Infirmary, and myself. Six were men, including himself, working in the same pit as he was employed in; the other two worked in the adjoining candle lighted pit. The knowledge possessed by these men of the disorder, and of the prevalence of Nystagmus in these workers with naked candles, is at once shown when it is stated that in the first mine in which my patient was employed the total number of men working underground was about 140, and of this number, 80 would be coal-getters; but as the trammers in this pit also did some amount of coal-getting, this last figure would perhaps be something over 100. Of this total, six suffering from Nystagmus were readily brought together by my patient, as those with whom he was personally acquainted as being afflicted. From the adjoining mine, belonging to different proprietors and employing about half a dozen more men, and with which my patient was of course less familiar, he also brought before me two cases.

NYSTAGMUS OCCURRING WITH GOOD ILLUMINATION.

Further evidence in support of the opinions expressed is found in the interesting fact that Nystagmus occurs in men who,

* *Vide* Appendix for Investigation of workers in candle lighted pits, at D.

though engaged underground, are not coal-getters, and who pursue their avocation in good light. I will make only brief mention here of cases of this kind that have come under my observation, for they will be related more in detail a little further on.

John H. (Case 111), aged 47, came to me at the Infirmary on October 14th, 1890. He had well marked Nystagmus, and had experienced symptoms for three or four months. He was employed as an "onsetter." He was "head hanger on" at the bottom of the shaft, his duty being to see to the ascent of the cage from the pit bottom and up the shaft. Now anyone familiar with a coal pit knows, that the bottom of the shaft is generally the best lighted part of the mine. In some collieries the electric light is employed, in others gas. In the present instance large oil lamps were used.

Thos. M. (Case 112), aged 28, was seen first at the Infirmary on April 26th, 1890. He also was an "onsetter," working at the bottom of the shaft. "There is plenty of light," he says, "from big paraffin lamps."

A medical friend informs me also of another case, but he has not yet come under my personal observation.

In these cases, Nystagmus is met with in men working in an excellent artificial light. Safety lamps, or even poor illumination, could not here be the cause. These cases will be further discussed when referring to position at work in its relation to the disorder.

In connection with this portion of the subject, the case of a compositor* may be mentioned, who came under my observation at the close of the year 1890 for Nystagmus. The case has been related before the Ophthalmological Society, and its interest here is that there is good reason for associating the disorder with the man's work. It will be necessary to refer to the case again. For

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* *Vide* Appendix.

the present it will suffice to say, that he was employed at a newspaper printing place, and that the composing room was well lighted in the ordinary way with gas.

THE PLACE OF ILLUMINATION IN CAUSATION.

The different points bearing on the question of illumination have been perhaps sufficiently discussed. Enough evidence has been advanced to show, that the allegation as to the employment of "Safety lamps" being the *prime*, much less the *sole* cause of Miners' Nystagmus, cannot be sustained. It has been shown that notwithstanding a noteworthy improvement in the illuminating powers of modern protected lights, the disease is not less frequent. The importance of not accepting any instances of alleged benefit resulting from simply changing from a safety lamp pit to a candle lighted one, has been shown, and cases have been mentioned in which either no improvement has taken place, or the condition has become worse. Moreover, the occurrence of Nystagmus in candle lighted pits, and indeed of men so suffering who have never used a safety lamp, thoroughly disposes of such a hypothesis ; and the fact of the existence of Nystagmus, and as it has been shown by no means infrequently, in miners working with candles, and further also in the instances mentioned of its presence in men not miners pursuing their avocation in good light, is evidence of a character preventing the acceptance of "safety lamps," or for that matter the mode of illumination, as playing a prime part in the causation of Miners' Nystagmus.

Imperfect illumination does indeed occupy only a secondary position in the production of the disorder, and reference will be made again to it in this way. Other things being equal, Nystagmus will be more frequent with the less perfect illumination. The worse the light the more will the effects of strain be experienced. I am bound to say, however, that the relatively large number I found off work at the naked light mine, of which

particulars have been given, was more than I was prepared for, and the same observation may be made respecting the knowledge that prevailed of the affection among the miners there.

Before passing from this subject I may mention some interesting observations on Miners' Nystagmus in the North of France, which have recently been published by Dr. Dransart.* The early cases he says, on which he made his first communication in 1877, were for the most part men who were working in pits lighted with naked lights. Out of 179 cases in which he had noted the illumination, he found the following figures, safety lamps 92 naked lights 87. It must be remembered that when Dr. Dransart speaks of the use of naked lights in the mines of the North of France, he is not referring to a candle such as is employed in Derbyshire, an account of which has been given. The naked light is, he tells me, an open lamp burning oil and worn by the miner, stuck in his hat. It gives a distinctly better light than the collier's candle, and as good, perhaps, as the small torch lamp used by the miners in England. Dr. Dransart has very kindly sent me one of these lamps, as used in his district. Safety lamps are employed in the North of France, in the part to which Dr. Dransart specially refers, in the proportion of two-thirds to one-third naked lights; and, whilst he found Nystagmus with greater frequency in the safety lamp pits, he says that, on the other hand, it existed without exception in all the others. He examined five naked lighted pits and one worked by safety lamps. He further explains that the greatest number of cases of Nystagmus occurred in the pits in which the seams of coal were thin, and the miner was obliged to work lying. He arrives at the same conclusion that I have, as just stated, viz., that all other things being equal, Nystagmus is more frequent in the pits lighted by safety lamps, that is to say, with the minimum illumination.

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* *Journal d'Oculistique du Nord de la France*, August, 1891.

Dr. Dransart gives a table of the different lamps employed in his district as follows :—

Taking as the type the standard candle (bougie de l' Etoile) we obtain the following tables for the different kinds of lamps employed in the basin of the Nord and the Pas de Calais :—

Bougie de L'Etoile - -	100
Naked lamp - - -	100
Boty lamp (single gauze) - -	0·67
Boty lamp (double gauze) - -	0·63
Marsaut lamp - - -	0·62
Mueseler lamp - - -	0·44
Davy lamp - - -	0·20

I have not given the different places where he says they are used. The Davy is disappearing, and its place is being taken by the Boty with the single gauze.

Chapter III.

POSITION AT WORK.

THE AUTHOR'S EARLIER INVESTIGATIONS.

WE must now pass on to consider in what way the Nystagmus of colliers is occasioned. We have dealt with the employment of safety lamps, and shown that for the prime cause we must look elsewhere than in the circumstances, so far as the manner of illumination is concerned, under which coal miners are engaged. In what direction then must we look, and in what channel must our investigations be pursued, to ascertain the conditions which give rise to Nystagmus ?

I have no doubt that the prime cause of the Nystagmus must be traced to the circumstances under which the colliers' work is accomplished, and it is my purpose now to set forth this contention with as much detail as necessary, and to support it by evidence which has accumulated in my hands, as the result of many years of observation.

As long ago as 1875* I stated that, "it seems to me that this disease (Miners' Nystagmus) occurs chiefly, if not entirely, in those colliers who are obliged to do their work in the pit whilst lying on one of their sides." Observation of cases at this time had pointed out to me this fact, as I regarded it, and I was then of opinion that Nystagmus was associated with a *particular class of colliers* performing a *particular kind of work.* The recognition of these two statements is I believe essential to the proper understanding of the causation of Nystagmus. These views, as to the intimate connection of Nystagmus with the work of the collier, gained support from further investigation, and were fully

* *Lancet* 1875, vol. ii. p. 81.

elaborated in a paper* read before the Ophthalmological Society of the United Kingdom in 1884. In this paper my contention was again re-iterated that the miners who suffer from Nystagmus are those "whose work necessitates their lying on their sides." Moreover, it was stated that "observation of cases of Nystagmus soon taught me that the patients so suffering had worked on their sides, and I believe of all the many instances at different times which have come under my notice, without exception, as far as my memory and records go, the miners attacked have been those whose work has been done on their sides more or less." The kind of work necessitating this constrained position is called "holing," and it is merely mentioned now, as further on it will be fully described. Among other evidence then advanced was an account of a visit paid by me to a coal pit, to verify, by actual observation of the men at work, the impressions gleaned by clinical experience. To put it briefly here, for in its proper place these observations will be more fully dealt with, the men whom I expected to find suffering from Nystagmus were so afflicted, whilst others pursuing different kinds of work were unaffected.

I have mentioned these early investigations of mine, because I wish to show how, starting with the original discovery that the colliers who suffered were engaged in a particular kind of work, further investigation has not only shown this to be the case, but has indicated that, around this is to be found the *prime essential cause* of the Nystagmus. My observations, to be now recorded, will bear out those already published and previously referred to. Further experience and a fuller acquaintance with the working of coal mines, moreover, has shown me that in other workers than those "working on their sides" (holing) an attitude is assumed necessitating a somewhat analogous position of the

* Transactions of Ophthalmological Society, 1884. I drew attention to the oblique direction of the Miners' gaze at the Ophth. Society in 1882.—(*Lancet* 1882, vol. ii. p. 103.)

head and eyes, and cases will be mentioned in which Nystagmus has occurred in men so employed.

INTERNAL WORKING OF A COAL MINE.

If one descends into a coal mine, or enquires into the internal working of one, it will readily be ascertained that the men engaged are of various classes, and the kind of work performed by each class is very different. Thus there are labourers or datalers, whose employment is to attend to the roads and airways and to keep them safe and in repair, etc.; "trammers" who push along the rails the tubs or "corves," as they are

Fig. 5.
A TRAMMER.
(*From a Drawing by Margery May, from the "English Illustrated Magazine," by kind permission of Messrs. Macmillan & Co.*)

called in Yorkshire, which have just come from the workings filled with coal, or to return the empties, and also a similar class of persons who attend to the conveyance of tubs, either full or empty, along engine planes or other road ways of the mine. There are also "drivers" or "pony boys." These latter are youths, the prospective colliers, who drive the ponies which convey the tubs along the tram rails of the roadways of the

mine. The classes of men thus briefly mentioned comprise something like about a third of all the workers underground.

Fig. 6.

PONY TRAMMING.

(From a Drawing by Margery May, from the "English Illustrated Magazine," by kind permission of Messrs. Macmillan & Co.)

In pits where protected lights are used these men employ "safety lamps," like the others engaged below ground, and therefore they work under similiar conditions of illumination. It is, however, recognised that Nystagmus is not met with among them.* Such is my experience, and it is amply corroborated by others.

Dr. Tatham Thompson,† speaking of South Wales collieries mentions the "absence of Nystagmus amongst the labourers and haulyers." Mr. Jeaffreson, of Newcastle,‡ also says, "It is certain that the malady is confined to coal miners, and it is equally certain that it is amongst this class *confined to those that hew coal.* To these two rules there is practically no exception." (The italics are mine.) Nieden, after examining the large number

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* This refers to *bona fide* "trammers"; in some pits, trammers also do coal-getting.

† *Lancet*, 1891, vol. i. p. 311.

‡ *Brit. Med. Journ.*, 1887, vol. ii. p. 109.

which he did, found Nystagmus confined to the hewers. Dransart is of a similar opinion.

The fact is then established that, with like conditions of illumination to that under which Nystagmus is met with, in the classes already mentioned, being about a third or more of the workers underground the malady is admitted to be absent.

The men employed in the pit who usually receive the name of "colliers" or "miners" are those engaged in coal-getting. On their labour all the others engaged depend. When therefore we reach the coal face, we find men engaged in getting the coal, and another class employed in filling the "corves" or "tubs" with the dislodged coal. The latter are called "fillers" or "loaders." They are generally young men, and being paid by the day, it not infrequently happens, that when no "corves" are waiting to be filled, they lend their aid to the coal-getters, many being by no means unwilling to do this, as they aspire to be coal-getters themselves. Nystagmus is exceptionally met with in these fillers.

The men engaged in winning or getting the coal, and the manner in which their work is accomplished, are those tha possess the most interest for us. The coal getter's business is to detach the coal from the coal seam in as large pieces as possible. To do this, he has to work in a peculiar position when holing or under-cutting the seam, preparatory to getting it down. He sits down with his legs crooked up, lying almost on his side, and strikes the coal with a horizontal swing of his pick at the bottom of the coal seam, his object being to undermine or undercut the coal. He will clear away the coal thus to a height of 18 inches or 2 feet; and then, as he gets deeper in, he draws his body under the coal, lying on one side or the other. The distance he may undercut the coal varies considerably. The process is called "holing," and sometimes he may continue undermining the seam of coal for two or three feet to as much as seven or eight feet. When he commences, he applies timber from the upper

part of the holing or undercutting to the floor of the seam, to support the coal whilst he undermines it. This is termed "spragging," and such "sprags" or timber supports should not exceed six feet apart, so that the miner may be securely protected from the coal falling upon him whilst lying on his side, holing or undercutting the seam to the required depth, before getting the coal down. The holing just described, in which the coal is cut under, is called "bottom holing." There are besides this, however, two other varieties. "Middle holing" is carried

Fig. 7.
UNDERCUTTING A THIN COAL.

(From a Drawing by Margery May, from the "English Illustrated Magazine," by kind permission of Messrs. Macmillan & Co.)

on near the middle of a seam, just where a band of shale or friable coal may occur. "Top holing" is done, as the word suggests, at the top of the seam, or between the top of the seam and what forms the roof of the working place. In all these varieties the miner will frequently have to get part of his body into the "hole" he makes and work there, lying on his side, to continue his work.

The coal having been thus undercut, the "holing sprags" or

"props" are removed, and if it does not fall down, it is detached by wedges, or gunpowder or other explosives in some mines would be used.

Other men may be engaged in what is called "cutting or driving the headings"; this work will be done directly forwards, with the pick swinging in a vertical line. The man will be either kneeling or standing, according to the thickness of the seam, when he does it, but with the head straight. These men are not, I think, liable to Nystagmus.

In some places the men called "headers" are also, for a part of their time, at all events, engaged in holing as well as doing the cutting or straight work that has been alluded to: men employed in this way of course come under the usual conditions as to the association of Nystagmus with the ordinary coal-getters. Such a miner is under my care at the present time suffering from Nystagmus.

PROPORTION OF MEN WORKING UNDERGROUND. ENGAGED IN "HOLING."

The proportion of men who hole in a mine is subject to very considerable variation. In some collieries every collier will "do his own job." Thus there will be men who do nothing but "hole," as there will be men who work straight forward at the "headings," others as "fillers," and others again at "buttocking" or "timbering." In other pits, a man may be required to do all sorts of work, to "hole," and detach the coal afterwards, or do his own "filling" and "timbering." Perhaps it may be fair, generally, to say that a third, or rather less, of the men engaged at the coal face, will be occupied as "holers." This is, at all events, as I have found it in some mines. At a colliery where naked candles were employed, and to which reference has been made, the coal was got by long-wall work. Each stallman "holed" his coal, detached it, loaded, etc. The work I have described as "heading" was not needed there at all.

Generally speaking, it would seem that the number of men who "hole" is larger now than some years ago was the case, that is to say, that the kind of work is more diffused among the colliers than it was. I have, however, endeavoured to arrive at some idea as to the percentage of men engaged in "holing." I am indebted to Mr. A. H. Stokes, H.M. Inspector of Mines, for information relating to his, the Midland, District. He says, "The number, in a large measure, depends upon the nature of the coal, and the amount of 'holing' required to get the coal. In some mines every yard of coal is holed; in others, little if any holing is done.

"In some mines a special class of men do nothing else but holing. In other cases the stallmen, or contractors for getting the coal, do the holing between them. Hence you will see the difficulty of giving figures which will apply to the whole of my District.

"I have obtained returns from some of the largest mines in my District, which leads me to conclude that from 20 to 30 per cent. of the persons working at the coal face are engaged in holing."

A well-known colliery manager has also kindly written for me the following account of the proportionate number of men employed underground who may be considered to be engaged in coal-getting and holing.

"The proportion of the men in the pit who are engaged in 'holing' is subject to very considerable variation. The amount of holing required varies in different seams, and even in different parts of the same seam. Sometimes this holing or undercutting the coal is done in the stratum immediately underlying the coal, if this be not too hard; sometimes in an interstratified band, and sometimes in the coal itself, though the latter is wasteful, as the coal holed out is almost valueless, and is usually thrown away.

"Perhaps the most usual practice is for the collier (placeman

or stallman) to do all the work required in his stall, in conjunction with a young man called a 'trammer.' The special business of the latter is to fill the loosened coal into the small wagon or corf, and take it to the sidings, returning with an empty corf. The collier, during part of his shift, 'holes,' and at other times gets down the coal, or attends to the timbering of his place. Sometimes, however, especially in Derbyshire, a collier takes a longer length of face, and employs several men to work for him. One or two of these are probably skilled as 'holers' and do nothing else. Consequently during the whole shift they are compelled to assume a suitable attitude, not only of the body, but of the head and eyes. There can be no doubt that the whole attitude and the set of the eyes is an unnatural one, and one which is fatiguing, though like everything else the men get accustomed to it in time. The contractor or 'butty' generally superintends the work of all the others, and especially attends to the timbering of the place. He is generally a man of middle age who has gone through the more laborious work when employed by other 'butties' in past years. Where 'holing' is necessary, about 30 per cent. of the work at the coal face is 'holing.' The relative proportion of colliers to general labourers and other underground work would be about 30 per cent.; the trammers would make up another 30 per cent.; and the off-hand men 40 per cent. This is equivalent to about 20 per cent. of the underground work being holing."

The men described as working straight forward "cutting" or "heading" do not, except they also do "holing" according to my observation, suffer from Nystagmus. The occasional instances met with in fillers will readily be explained when the tabulated series of cases are analysed, and will be found not to be at variance with my contention that Miners' Nystagmus is associated with the work called "holing," or one necessitating a somewhat analogous attitude of the eyes.

HOLING: ITS RELATION TO NYSTAGMUS. VISIT TO A COAL MINE.

I will now advance evidence showing the intimate relation of this kind of work (holing) to the existence of Nystagmus.

I felt convinced years ago that if I had an opportunity of seeing the miners at work in the mine, I should find that those suffering from Nystagmus were engaged at the work alluded to. Accordingly in June, 1883, accompanied by one of my students, since deceased, I went down a colliery near Barnsley. This mine was selected because one of the under-viewers was at that time a patient (not for Nystagmus), and he was anxious to be my guide. The pit was a large well-ventilated one. Several hundreds of men were employed underground, and safety lamps were used.

My guide took me at first to the "coal-getters." Three sets of these men were examined who were engaged in "cutting the headings," working with the pick swinging in a vertical line directly forward, in the manner already described. In none of these men was Nystagmus found. Then I was taken to the men engaged in "holing" or undercutting the coal, and four of the six men working at the places I went to, suffered from Nystagmus; the two who were unaffected were young men. Trammers, and men otherwise engaged in the pit were examined and Nystagmus was not found among them.

It is not easy to over estimate the value of such evidence. It is not, however, intended to give the impression that my examination was a thoroughly exhaustive one of the workers in the mine. As it was, the time occupied was considerable, but a systematic and regular examination of all the workers in a large mine would mean an immense expenditure of time and labour. The observations were, however, complete in examining the different kinds of workers underground, and amply confirmed the clinical experience gained from patients who had been under treatment. Further, this visit, as well as a later one,

impressed on me the importance, in investigating this question, of a personal acquaintance with the interior of a mine. Such a visit, moreover, goes far to convince one that the position assumed by the miner must be an important factor in the causation of Nystagmus. Dransart* has also insisted on this in these words, "It suffices to have made one visit only to the miners at their work to comprehend the part played in Nystagmus by the work at the seam."

If we now refer to our tabulated cases, we shall find conspicuous support given to the relation of "holing" to Nystagmus. I have made a calculation that, at one time or another, fully 500 cases† must have passed under my observation for treatment. I lay particular stress upon this, for my clinical results are based on cases that have sought me; a very different matter from seeking the cases myself. At the time I commenced to write this volume, fourteen cases were on my books at the Sheffield General Infirmary. In the tables will be found cases under different dates, varying from 1877 onwards, the greater number being from about the last year, or eighteen months, as during this time I have been more careful to make and to preserve the notes. The facts have been written in the patients' papers at the Infirmary at the time of their first attendance; they vary much in completeness, and many have been lost. The 127 cases here recorded in the appendix comprise all that I have been able to find notes of. Except those referred to as a special examination at a candle lighted colliery, all the cases have come to me for advice. I have expressly excluded mention of any that, with the exceptions stated, I may in any way have sought.‡ In a very few cases there is no

* Dransart's *Annales d'Oculistique* vol. ii., p. 114, 1877.

† The miners examined at candle-lighted pits, besides the first series, are excluded from consideration in this analysis of cases.

‡ The total number of miners with Nystagmus seen by me at different times and places must very largely exceed this; possibly twice as many.

remark under the heading—kind of work. I include these as coal-getters (holers), because if they had not been, the fact would have been recorded; in the same manner I have included all cases as working with safety lamps, except where the contrary is mentioned. Questions as to these points would have been asked of each patient, and if there had been exceptions they would have been noted.

Taking now the 127 cases, and looking at the kind of work which has been the occupation of the men, we find that there are 119 who are coal-getters, doing what is described as "holing" more or less; to these, three more must be added, viz., "fillers," because though not regular holers or coal-getters, I shall show later on that men of this class occasionally do work of this kind. The other five will not be found exceptions to the views I lay down, and will be discussed in detail.

ON EXAMINING PATIENTS AS TO THEIR MODE OF WORK.

For a considerable time in examining any patient afflicted with this malady, it has been my practice not to put any leading questions as to the kind of work which he may have performed, but rather to get him to demonstrate himself, as much as possible, his attitude at his work. This has been done for two reasons. Firstly, to avoid leading the patient in any way as to the nature of the information required. Secondly, because it will be found that the terms employed by miners for their special work vary considerably in different parts, and in this way, no doubt, error has often arisen. A patient then is asked what his work is, and when he replies that he is a coal-getter, he is further asked how he gets his coal. In this way, sooner or later, avoiding any leading question, frequently he will say, "Why I hole it," or some such words. Further than this, generally speaking, the patient, before the investigation is completed, has to go down on the floor

and put himself in the position in which he would be at his work.*

By adopting a method like this it has become clear to me that there are other kinds of employment, in the mine which necessitate an almost analogous position of the eyes to that assumed in "holing." In some of the Derbyshire collieries there is work done which is called "raking," in which a man will put himself in the position similar to that for commencing "holing," but continue it for such a short distance that he does not "go under the coal." Some coals are after this process easily detached. Another kind of work called "clodding" is represented in the engraving (*Fig.* 8). It is very similiar to "top holing." The man is 5 ft. 7 in. in height, and he is working under a roof less than 5 ft. high, with his head on one side, clearing the "clod" or rubbish off the top of the seam of coal. He was under treatment for Nystagmus (Case 74), but he was also a "holer." These examples will suffice, others will be given later on, to show that it is essential, in investigating a case of Nystagmus, to obtain as far as possible a demonstration of the kind of work done. In this way a case, which from the miner's first account may be obscure, becomes perfectly clear. Moreover, it is often only in this way one can get away from the oft repeated, "It is the lamps as does it," and which so prejudices the miner's representation of his case.

* The name given by the miner to his work is often misleading. The two following recent instances will illustrate the need for careful investigation. A patient informed me he was a "trammer." He was asked if he did anything else, and he replied in the negative. It subsequently transpired that he was a "trammer," but that all the trammers in his pit also did coal-getting. He "holed" regularly for the first three hours he was in the pit, and did ordinary tramming afterwards. The second was a "header"—in this case it was elicited that though called a "header" he did holing daily. A less careful examination would have led some, perhaps, to think that here were cases of Nystagmus occurring in a "trammer and a "header," whereas they merely conformed to the usual conditions under which the affection is associated with the coal-getters.

Fig. 8.

"CLODDING" OR "BANNOCKING."

(*From a Photograph of a Miner, who placed himself in position.*)

The hands are too low for striking with the pick; they should be more on a level with the right shoulder.

It may be mentioned that the association of Nystagmus with the particular kind of workers which my cases have demonstrated, has not escaped the notice of others. For instance, Dransart, whose painstaking observations on the affection we are discussing are well known, alludes in a foot note attached to his paper in the *Annales d'Oculistique*, 1877, vol. ii. p. 121, to the men working in the shallow inclines, constantly lying; and adds,* "We should note this fact, that all our workers attacked with Nystagmus work in these inclined seams." His observations will be again alluded to.

More recently, Zieminski,† who "has made a special study of Nystagmus in England, attributes the muscular anomaly to the constrained attitude of the work of the miners, their look being forced to direct itself obliquely above either to the right or left." In my paper read before the Ophthalmological Society, I referred to Nieden as assigning the cause of Nystagmus to the use of safety lamps. He kindly wrote shortly after, pointing out that I had not quite correctly interpreted his views, as he had also found Nystagmus in pits where the ordinary naked light lamps were used. He said, further, "In all my papers about Nystagmus I stated as the *first*‡ *prime* cause of this affection, the particular kind of work the *hewers* had to do in holing the coal in a stretched position of the body, head and eyes."

PATHOLOGY OF THE AFFECTION.

Miners' Nystagmus is I believe a myopathic disease. It is, indeed, a local affection, and as a result of prolonged strain in an unusual and constrained position, often for long and frequently recurring periods, chronic fatigue in the ocular muscles is brought about, and atony being induced, oscillation of the globes is

* Nous devons noter ce fait que tous nos ouvriers, atteints de Nystagmus travaillant dans des gisements inclinés.

† Analysed in *Rec. d'Ophthal.*, 1889, p. 637.

‡ The italics represent underlined words in the original.

caused. In the state of rest all may appear right, but attempt to put into action the muscles implicated, and the disordered movements are evident. This kind of Nystagmus is another instance of muscular disability induced by over-work. Its pathology is similar in this respect to writers', pianists', and other forms of professional neuroses. This is the view also taken of the pathology of the affection by Dransart. The analogy of Miners' Nystagmus to writers' cramp, and other like conditions, is well stated in the following words of Dr. Bell Taylor,* "It is analogous to that rare condition of the muscles of articulation known as auctioneers' spasm, or to writers' pianists', and telegraphists' cramp, or to a similiar affection of the gastrocnemic muscles occasionally observed in ballet dancers, who run and pirouette on tip toe until they are attacked by cramp, spasm, and uncontrollable motions, whenever they attempt to dance at all." To add to this list of analogies is the interesting case, to which reference has already been made, of the occurrence of Nystagmus in a compositor, and to complete the connection is the more recent development of compositor's cramp in his right hand. Mention may also be made of the tremors and spasmodic actions of the muscles of the neck, and elsewhere, met with in miners, and which can only be regarded as belonging to the class just spoken of, and the association of Nystagmus with these conditions is interesting and important as pointing to a common cause.

Dransart † held that the disorder was due to the fatigue induced in the elevator muscles in consequence of the cramped position of the miner occasioning strain and a constant upward movement of the eyes. "The myopathy," he says, "will have its principal seat in the superior rectus and inferior oblique muscles; it occasions merely a weakness in these organs. The

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* *British Medical Journal*, 1887, vol. ii. p. 483.

† *Annales d'Oculistique*, 1877, vol. ii. p. 128; 1882, vol. ii. p. 150.

pair of elevators having an acquired feebleness cannot overcome its antagonist by a single effort; it is obliged to attempt it several times by means of a series of little successive and rapid contractions. It then produces Nystagmus or rather gives occasion to the vertical oscillations. To explain the horizontal oscillations which are noticed in Miners' Nystagmus we have recourse to the paresis of the internal recti and the accommodation. The impotence of the internal recti can suffice to explain the horizontal oscillations; they are produced by the same mechanism as the vertical ones. But the accommodation contributes to increase the muscular disorder by virtue of the relations which exist between convergence and accommodation, or in other words, between the ciliary muscle and the internal rectus."

If we now consider the position of the miner engaged in "holing," we shall, I think, conclude that the direction of the eyes is not sufficiently described as "the constant upward movement of the eyes." There is something more than this, as I have pointed out in my previous writings, and I am pleased to say that Dransart and myself are in agreement on this point. In his paper* quite recently read before the French Ophthalmological Congress at Paris, he spoke of the "raised and oblique position of the gaze," and in a letter † published just now in the *British Medical Journal* he further testifies to our similarity of views on this matter.‡

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* *Rec. d'Ophthal.*, May, 1891.

† Printed in Appendix.

‡ As long ago as 1882 in a discussion at the Ophthalmological Society (*Lancet* 1882, vol. ii. p. 103), I stated that in my opinion the position of the miner's gaze at his work was an oblique one. In my paper at the same society in 1884 I not only insisted that this was so, but that such a contention was in accordance with the kind of oscillations present in Miners' Nystagmus, and that the muscles involved were those that I have set forth above. I am pleased, then, to see that not only are Dr. Dransart and myself in perfect accord, but that he has been good enough to recognise my insistance on the points just given.

The constrained position of the miner in "holing" has already been mentioned. It is work common not only in this country but on the continent. The French name expresses its cramped nature: "*Travail à col tordu.*" A miner lying on his side engaged in holing, either whilst commencing the "hole" or whilst continuing to work under the coal, will of course fix his gaze at different parts according to where it is necessary to strike, for his eyes will follow his pick point, but the tendency will be for the gaze to be directed upwards* more or less obliquely. I have satisfied myself on this point times without number. The miner will lie on his side, sometimes the left, sometimes the right, as is most convenient; his legs will be crooked up, his head thrown back and flexed more or less on the shoulder beneath, and the eyes will have the direction as just mentioned. I say this because I think the oblique muscles play a greater part in occasioning the Nystagmus than Dransart's views originally seemed to show. The Nystagmus should otherwise be more vertical in character. The compositor's case, which has already been alluded to, in which the gaze had been directed more directly upwards, and in which the oscillations were vertical, supports my contention.

The physiology of the ocular movements is also of interest and value on this point, because when we incline the head to one † side or the other, by turning it on its antero-posterior axis, rotation of the two eyes upon their antero-posterior axis takes place probably by the instrumentality of the oblique muscles. This is important to remember in connection with the "holer's" attitude

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In a recent paper, which has often been alluded to, he says, speaking of myself, "This author has sustained with reason that the external rectus muscle was interested in Nystagmus in the same degree as the internal rectus, and has put in relief the importance of the oblique gaze to the left or to the right."

* Upwards, by this is always meant a direction towards the vertex, bringing into play the elevator muscles.

† Carpenter's "*Physiology*," p. 896.

when engaged in "holing," and with what has been said about other kinds of work in the pit occasioning a somewhat similar position of the head and eyes.

A miner working on his left side will be using, in the left eye, the superior rectus, the inferior oblique, and internal rectus; and in the right, the same two first named muscles, but substituting the external for the internal rectus. If he works on the opposite side the arrangement will be reversed. The to-and-fro movements met with in Nystagmus are thus accounted for by the weariness of the outer and inner recti, the rotatory by the inferior oblique, and the superior rectus aids here in occasioning the vertical movements.

Before leaving this portion of my subject I may mention as worthy of note, the ready manner in which discomfort is occasioned and Nystagmus rendered evident, even in cases that have improved by rest or change of work, by assuming the position required in holing. Not infrequently the oscillations become evident when before they had not been perceptible. Moreover, a miner may often have so far recovered that his Nystagmus may have ceased to trouble him, but on assuming the old position, at one's request, the oscillations become at once manifest. The miner whose position at work is depicted in the engraving from a photograph *(Fig.* 9), was taken when he regarded himself as cured, and after leaving the pit had followed another occupation (gardening) without discomfort. When he placed himself in position for the photograph he felt his eyes uncomfortable and could not bear the strain for long. Some men are accustomed to do their work with one side down more than the other, and not infrequently the oscillations are more marked on looking to one side, and it is often possible thus to tell the patient on which side he has been most accustomed to work. I find this fact noted in 13 cases in my record, but the condition was not always

Fig. 9.

"HOLING:" A MINER LYING ON HIS LEFT SIDE IN POSITION FOR WORK.

(*From a Photograph of a Patient, who placed himself in position.*)

looked for. I have also seen men* who, unable to continue work on the right side or *vice versa*, have been able to do so on changing to the other, and consequently thus directing their eyes in a different way.

The process known as "holing" has been fully dealt with because of its close association with Miners' Nystagmus. The different engravings will, it is hoped, together with what has been written, have conveyed a good idea of the strained position not only of eyes but of body as well. Wishing, however, for the purpose of this book, to obtain from a perfectly independent, as well as reliable, source a description of "holing," I wrote to an eminent colliery manager, with whom I had no personal acquaintance, nor was he, as far as I knew, aware of my views on Miners' Nystagmus, asking for a description of a man's position in holing. In reply he sent me over one of his under managers, who had had 40 years' experience as a practical collier in "holing" as well as other pit work. He was a most intelligent man. I had neither seen nor heard of him before, and he dictated the following account of "holing," which I give in his own words.

"A man to commence holing will sit down on one heel with the other leg spread out, until he gets two feet under the coal. At that time the head will be directed sideways on the low shoulder. Then to go forward the next 12 or 18 inches he will sit down (on his buttocks) with his head and body nearly in the same position, the head flexed on the low shoulder and turned slightly up. For the next two feet or more that he may undercut, or 'hole' the coal, he will have to be under the coal, to lie

* The late Mr. Oglesby, in the *Transactions of the Ophthalmological Society* for 1882 (page 249), mentions an interesting case. "A peculiarity in the case is that the man is left-handed, and when getting coal the head and neck are flexed on the left shoulder. At present he has much difficulty in getting coal when in that position, but by flexing the head and neck on the right shoulder he can still do a fair amount of work."

down straight out, working with the low elbow on the floor and the head flexed on the low shoulder and turned slightly up."

This account has also received the consent of the colliery manager himself, and it may therefore be received as reliable, and may be compared with the descriptions given by myself.

The difficulties attending the obtaining of an exact representation of a man's face and eyes when engaged in "holing" are very great. At his work the face is necessarily partly hidden from view, and though by the kindness of friends several photographs which had been taken in the pit both with the electric light and the flash light have been placed at my disposal by those who had taken them for quite different purposes, yet they too, like the picture I am just now going to speak of, were open somewhat to criticism, because the collier had of necessity to assume a pose for the photograph to be taken. I have therefore determined to use again the same photograph which illustrated (lithograph) my paper in the transactions of the Ophthalmological Society for 1884, to show as before a "miner lying on his left side in position for work," with the most unprejudiced criticism upon it that I have been able to obtain.

The miner was a patient who had recovered, or nearly so from well-marked Nystagmus. He consented to have his photograph taken, and came prepared with his working clothes, pick and lamp. The latter was an old Davy lamp, but as will have been gathered from what has been said when speaking of safety lamps, it is now practically obsolete. The portrait (*Fig.* 9) was taken in the latter part of 1883, or the beginning of 1884. The man was desired to put himself in the position he would assume at work. It is clear that he has fixed his eyes in the artist's studio higher than he would do when at his work in the mine. The position a miner's eyes will assume whilst "holing," is better shown in Dr. Dransart's photograph of a miner working in a shallow seam (*Fig.* 10). The same under manager of a colliery

Fig. 10.

ATTITUDE OF A MINER, WORKING IN A THIN SEAM, VARYING FROM $0^{m}40$ TO $0^{m}80$ AND 1 METRE.

(Dr. Dransart's Photograph.)

whose description of "holing" has a little way back been given, has made the following criticism of the photograph (*Fig.* 9) of my patient. In fact it was in consequence of my submitting the same portrait to his superior, for an unbiased opinion on it, that he came to see me, and gave me both the description of "holing" which has been mentioned and the criticism of my photograph. He says "A man commencing 'holing' will sit on his heel, his body will be more upright and the head more sideways on the low shoulder than is represented in the photograph; the eyes will naturally follow the place where the pick is striking; this is more direct work than when under the coal. The hole at the front would be about 18 inches high. For a man working well under the coal the head and shoulder will have to be lower than represented in the photograph; he keeps his head as much as possible flexed on the under-lying shoulder; this must turn the eyes obliquely; the under-lying elbow should be working on the floor. The man is making too big a hole and too much small coal."

With this criticism should be considered the description given of "holing" in the text.

The same authority says of the man represented as holing a thin coal (*Fig.* 7) that the head is too straight. It should be more on the under-lying shoulder.

The two other photographs illustrating this kind of underground work were both taken in the mine by means of the flash light. I am indebted to the Rev. H. L. Deering for kindly placing at my disposal his large collection of photographs taken by himself in the mine. In one now reproduced a miner is represented lying under the seam of coal engaged in holing (*Fig.* 11), and in the other (*Fig.* 12) a view is presented of the coal face after the seam has been "under cut" or "holed," and it shows the wooden supports or "sprags" to which reference has been made in the text *in situ*.

ANALYSIS OF CASES.

Among the 122 cases which have been classified under the head of those engaged in doing "holing" are three fillers, or more correctly four, as a "loader" is mentioned with those examined at the naked light pit. These might at a casual glance appear as exceptions. In reality they are not. Nystagmus is only infrequently met with in "fillers" or "loaders," and these are the only three instances as far as I recollect that have at any time come under my observation. The "filler" works at the coal face with the colliers. His employment consists in filling the corves or tubs with coal. He is the embryo coal-getter. That is the next step, and he aspires to be a coal-getter. He is paid generally by the day, and not only is it required of him to lend a hand at getting the coal when he has no tubs to fill, but he is very willing to do it, as it fits him for the work he intends pursuing. In one case (Case 108) there was some little difficulty in ascertaining from the lad as to his doing this coal-getting and holing. He was inclined to assert that he did not do this work in a way that would perhaps have satisfied one less determined to get to the bottom of these cases. He came some little distance, and as the men he worked with would not come to see me, it was resolved that we should pay them a visit, and ascertain the truth as to his manner of work. Accordingly, in company with Mr. Wightman, Assistant House Surgeon at the Sheffield General Infirmary, I went into the country and interviewed the men with whom he regularly worked, and put it altogether beyond question that he never passed a working-day without "holing." As to the other cases inquiries were also made with similar results.

It is well to remember that filling a tub in a mine is quite different to filling the same tub on the surface. In the first case, when the thickness of the seam is less than the height of the loader, the roof prevents him standing upright, and the whole of his loading is done in a more or less stooping position; whereas if loading the same tub on the surface, the man

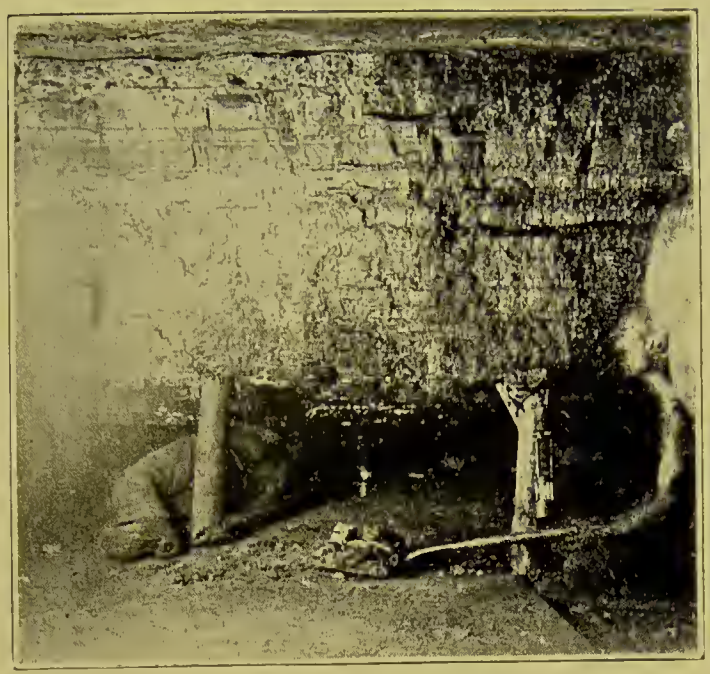

Fig. 11.

MINER HOLING UNDERNEATH A SEAM OF COAL.

(From a Photograph taken in the pit with Magnesium Light.)

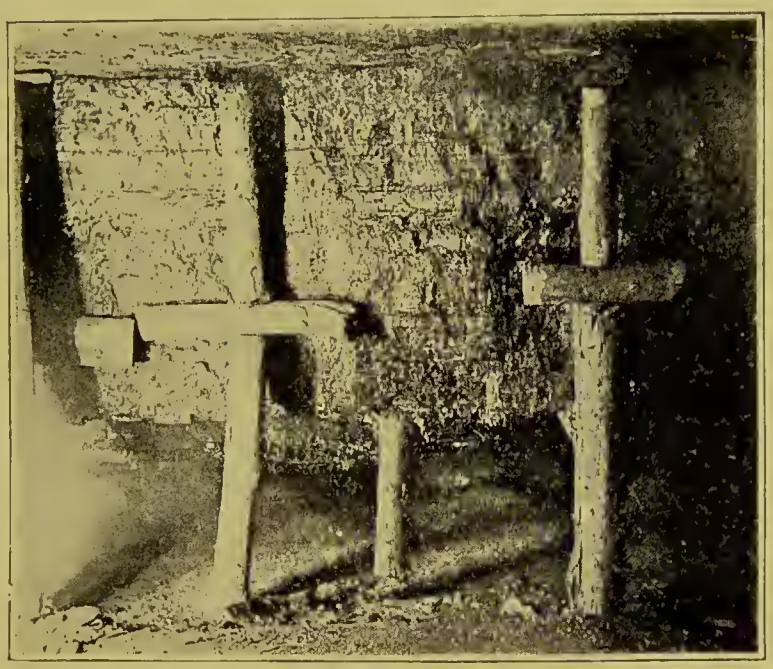

Fig. 12.

COAL AFTER BEING UNDERCUT (HOLED), SHOWING WOODEN SUPPORTS (SPRAGS) IN POSITION

(From a Photograph taken in the pit with Magnesium Light.)

can raise his head and body to any height required, and throw the material into the tub without limit of space. Miners with Nystagmus sometimes complain that loading or indeed any shovel work underground is irksome, and the conditions under which this work is accomplished should therefore be understood.

For many years I have been especially on the look-out for cases of Nystagmus occurring in what may be called exceptional circumstances. Those which will now be mentioned are the only ones that have come under my notice, and it will be shown how they cannot be regarded otherwise than as lending support to the contention set forth in these pages as to the cause mainly instrumental in occasioning the disorder.

Mention may here be made of a case (Case 84) sent to me by my friend Mr. Makeig Jones, of Wath, as an instance of Nystagmus occurring in a worker in a coal pit, but who was not a miner. He was a young man aged 24. Slight Nystagmus was found to be present, and it was only rendered evident on his looking upwards obliquely, especially to the left. He neither now, nor did he appear at any time to have, suffered from symptoms of Nystagmus. He had worked with candles as well as with safety lamps. He had done coal-getting and "holing," and though his work consisted now in "shovelling stone and coal," he acknowledged to still occasionally working at coal-getting. He did a great deal of his work standing up with his head sloping, like what has been described as "clodding." There was an absence of symptoms. He made no complaint of objects moving at any time. It appeared correct, therefore, to regard it as one in which the Nystagmus may have been present for some time without producing the usual train of symptoms. Such instances are not at all infrequently seen at the Infirmary in patients attending probably for some other condition. The Nystagmus has attracted attention, but inquiry has shown the absence of symptoms. For these reasons, then, this case has not been withdrawn from those already classified.

Let us now proceed to consider the exceptional cases. They are five in number.

1. First are two deputies. Until quite recently I had no knowledge of this class of men suffering from Nystagmus. Both the cases were observed when examining the workers in a naked light pit.

The duty of a deputy is to enter the pit and examine the workings for the presence of gas before the men go to their work, and also to remain in charge of the mine or district of a mine whilst the men are at work. One part of his duty is to ascertain carefully the condition of the roof. Deputies are selected for their position for their intelligence and steadiness, and they are in fact the manager's deputies, or under-officials of the mine. I will give one of these cases in detail, and then explain how it appears to me the Nystagmus is to be accounted for.

C. W., aged 32 (Case 114), has worked in a coal mine for 22 years. He has been engaged at coal-getting and holing, but for the last eight years he has been a "deputy." He previously used candles, but though working in a naked light pit, it is necessary for him to employ a safety lamp. The one he uses is a Hepplewhite-Gray (*Fig.* 13, Ashworth's patent), a lamp a good deal employed, he tells me, for detecting the presence of gas. He works a nine hours' shift, that is to say, he is in the pit at work for eight hours. For about four continuous hours he is in the working places, from four to six feet high, examining the state of the roof. On ascertaining that he was suffering from Nystagmus, and learning also that he was a deputy, he was at once asked to place himself in the position he would assume in the pit for examining the roof. He did so with his head on one side, and the eyes directed obliquely as expected; there were several colliers present in the room when

Fig. 13.

Fig. 14.

"DEPUTY" EXAMINING ROOF UNDER 5-FT.

(From a Photograph of a Deputy, who placed himself in position.)

the examination was made, and they fully agreed as to the correctness of the position he assumed before me. The case bore out so well my views, and afforded so clear an explanation of the occurrence of Nystagmus in this particular instance, that his consent was obtained to have his photograph taken. He accordingly came to Sheffield for that purpose. The simple direction given was, "Put yourself in the position for examining the roof under five feet" (he was 5 feet 6 inches high). As he thus placed himself he was at once taken by the photographer. This portrait (*Fig.* 14), which is reproduced here, has been since shown to several men who were accustomed to see him at his work, and they are agreed as to its faithfulness, as indeed was also the deputy whose case will next be referred to. The ocular movements were well marked and he had experienced symptoms for twelve months, and had been off work for five weeks some months ago. He finds stooping and looking up makes his eyes bad, and he tries to keep them directed downwards as much as possible. After keeping himself in the position for his photograph, he had to turn his gaze downwards to get them comfortable. It must be remembered that in the mine if he raised his head to his full height it would strike against the roof.

He was anxious I should also have a photograph of his position when "examining for gas," and accordingly had one taken by an amateur, in his working clothes (*Fig.* 15). It has been submitted to mining authorities, and its correctness as showing a deputy's attitude when testing for gas has been acknowledged.

The second deputy, J. W. (Case 115), was a man aged 44; he had worked in a mine for 34 years. He had been a "deputy" for eight years, and before that time he used candles and worked at coal-getting and "holing." He states that symptoms of Nystagmus had been experienced for two years. The ocular movements were not, however, as well marked as they were in

the last case. He used the same description of safety lamp as did the other "deputy," and his work was similar. He agreed that the photograph (*Fig.* 14) was correct and represented the position he himself occupied daily for a considerable time.

Both these men, it will be noticed, had previously been engaged in "coal-getting and holing" and using naked lights. There is, however, no evidence of their having suffered during this period from Nystagmus, and I accept the cases as developing the malady during the time they have been deputies, and the explanation given of muscular strain is, in my opinion, the correct one.*

I am indebted to a non-medical correspondent for telling me of the following case. I have not seen the patient, but the facts are so well told that I have no doubt as to their accuracy. My correspondent of Bolton, with whom I am personally unacquainted, knowing, as he says, my interest in Miners' Nystagmus, wrote to me, saying he thought I should like to hear of this case. He had, it appears, found out that the man really had Nystagmus, and he had studied the kind of oscillations present; the eyes were steady except when looking upwards. He had put to the patient the theory that was held by some that safety lamps were the cause of Nystagmus, and he replied "that whatever might be the case with others, deficiency of light could have played no part in his case, as there was always plenty of light in the passages." This man was a "deputy"; he had not worked at coal-getting for twenty years; since that time he has been a deputy; his age is 39. The colliery he is employed in

* A man, M. P., aged 39, is, as this passes through the press, under my care. His case comes under this class. For many years he has had to see to the ventilation, and for this purpose his time from 6 a.m. to 2 p.m. is occupied in the mine in going about low passages and working places, the height of these being about 4 feet 6 inches, whilst he stands perhaps 5 feet 10 inches. He carries his head chiefly on the left shoulder, and the Nystagmus is most marked in looking up and to the right. He is obliged to keep looking up, he says, to avoid "tipping" his head against the roof.

Fig. 15.

"DEPUTY" OR "FIREMAN" EXAMINING FOR GAS IN A SEAM UNDER 5-FT. THICK.

From a Photograph.

has no shaft, but is entered by an incline from the surface. His chief work consists in examining the roofs of all the passages in the pit. His height is 5 feet 6 inches ; the average height of the workings about 5 feet ; height of the passages 3 feet 6 inches. He has charge of half the workings and the entrance tunnel, which is also the intake for fresh air. This entrance tunnel is lighted by torch lamps suspended from the roof. The chief part of his work consists in the examination twice a day of the roofs of all the passages in the pit, and in doing this he holds his head very much on one side. He carries an improved Clanny lamp with him, except when examining the working places for gas which is very quickly done. For this he uses a Davy lamp. He attributes his affection to having had some time back to examine a long length of tunnel about 300 yards, closely set with props and bars. The passages are similar in what he has to look after now, but they are shorter. A man who worked with him some time back in a similar way, also, he said, suffered from Nystagmus.

I have given the essential points from my correspondent's excellent description. The case is just like that of my own deputies, but it is of interest from the fact that the man appears to have done the bulk of his work, viz., that of examining the passages, in a good light.

The next case (Case 113) is one also of considerable interest. His age was 28, and he came to me in December, 1882. He complained of the lights dancing and other symptoms, but the ocular movements were not grave, and they were not always noticeable. He had had symptoms for two years, but especially during the last three months. He was an engine man at the bottom of the pit. The notes made at the time were fairly complete, but as the patient had never been a miner the case was one of unusual interest, and it was determined, therefore, to try and find him, as he had not been seen for more than eight years. We were successful, and he paid me a visit in April, this year (1891). It has been

mentioned that he was an engine man. It was found now that the name given to his employment was misleading. The place where the engine was situated was 20 feet high, and well lighted; he had a lot of work to do, however, in attending to the pipes under five feet and less in height, his own height being 5 feet 10 inches. He had to lie on his side attending to the pipes, and his work necessitated the frequent turning of his head on one side, very similar, as he said, to that assumed by a man holing. He worked with paraffin lamps, but he also employed a safety lamp when it was necessary to go to the donkey engine, which was some distance away. Acting on my advice given in 1882, he ceased this kind of work, and obtained employment on the pit bank. He still, however, has to go into the mine frequently, and he still uses a "safety lamp." He travels with it 1000 yards down an incline, and then 500 yards more to reach the workings (donkey engine). He is engaged in no work now necessitating such a position as was formerly the case, and though he still uses a "safety lamp" a good deal, he is perfectly well, and has indeed been so for several years. There are no oscillations of eyeballs discoverable by any means, nor has he had any symptoms since shortly after the change in his mode of work.

The remaining two cases are of peculiar interest, and special attention is asked for them, because they both worked in a good light, and the question of safety lamps or imperfect illumination has therefore no place. They were both occupied at the bottom of the shaft. They have been previously mentioned, but it will be necessary now to enter more into detail.

The light at the bottom of the pit shaft will be admitted to be fairly good. As already mentioned, in some pits it is lighted by electricity or gas, and in others by large paraffin or oil lamps.

One of the patients (Case 111), was a man, J. H., aged 47, who came to me in October, 1890. He had suffered from the lights dancing for the last three or four months. Nystagmus was present but not severely. He worked at the bottom of

the shaft as an "on-setter." There is, he says, "plenty of good light from oil lamps." He has never worked as a miner, and has not done any coal-getting nor holing.

It may be explained that the "on-setter" is the man in charge of the pit bottom; his duty is to take off the empty tubs and put full ones on the cage, also to give signals to the surface, and superintend the arrival and dispatch of men into, or from the mine. During such work his head and eyes are frequently turned on one side, watching for the arrival of the descending cage, or seeing the ascending one safely away from the pit bottom.

Careful inquiry has been made as to the manner in which these onsetters must direct their eyes. Mine authorities have been questioned, and inquiries have been made of those who see such men daily at their work, and of another man, besides the patients mentioned, who had actually done the same kind of work himself.

Returning to J. H. again, we find he is a head "hanger-on" (or "on-setter"). His work is to "ring-off," *i.e.*, when the tubs are full he signals to the top, and then when these ascend, the other cage comes down with empty ones. He stands at his work and should look up to see the ascending cage safely away, and receive the cage coming down; other men shove the corves on to the cage.

The statements here given as to this man's work were supported by three other patients from the same pit, who constantly saw him at his post. Moreover, as my patient came up to you, he did so with his head on one side.

The other case (Case 112), was that of a younger man, T. M., aged 28. He is not engaged in coal-getting; he is not a practical miner. He works at the bottom of the shaft. "There is," he says, "plenty of good light from big paraffin lamps." He came to me in April, 1889. He was an "on-setter," and it is not necessary to describe the case in more detail.

Now, in these two cases, it is evident the "light" question

does not come in. There are many occupations above ground which are pursued in no better, and frequently in worse light. The explanation given, as to the causation is, it appears to me, correct.

Viewing the five exceptional cases together, it is evident that there are instances of men working underground who suffer from Nystagmus, and though not working at coal-getting, are pursuing their avocations in a manner that is in accord with the views set forth in these pages as to the prime cause at work in occasioning the disorder.

We have thus considered the cases alluded to as to their manner of work in some detail; others have come under my notice since these were compiled, and several additional ones are referred to in different parts of the text, and they all strengthen the views as to the kind of employment which is so prejudicial. The cases dealt with come out roughly in percentages in the following way :—

119 coal-getters 3 fillers, doing coal-getting	= 122, or 96	per cent.
2 deputies - -	= 2, or 1.6	per cent.
2 on-setters - -	= 2, or 1.6	per cent.
1 engine man (misleading description)	= 1, or 0.8	per cent.
Total 127.	100. 00	

The figures thus given correspond precisely with those just now recorded by Dransart,* as the result of an analysis of cases met with by him. He gives coal-getters (haveurs) as 97 per cent.; timbermen (boiseurs) 2 per cent.; and other workmen 1 per cent. I have not met with any cases occurring in "timbermen" pure and simple. Generally speaking, with us in the Midland Districts, I think the timbering of the working place is done by the coal-getters, who are also more or less engaged in

* *Journal d'Oculistique du Nord de la France*, August, 1891.

Fig. 16.

"SETTING TIMBER" IN A THICK SEAM.

(*From a Photograph taken in the Mine with the Electric Light.*)

holing.* In this way the stall-men mentioned in the naked-light inquiry did their own "wooding." I see no reason why these men should not occasionally suffer from their style of work, whether they kneel in a thin seam or stand in a thick one, and this is rendered clear to me by photographs taken in the mine of men actually engaged in "timbering." I have selected from these photographs kindly placed at my disposal, one taken by Mr. Sopwith in the Cannock Chase district. It represents (*Fig.* 16) men setting timber in a thick seam. Miners afflicted with Nystagmus find "timbering" very trying work. In fact, the more the subject is studied, the more it becomes evident that whether from the lowness of the levels and working places, or other circumstances, inseparable from coal mining, the malady will occasionally be observed in others than actual coal-getters. The on-setters, the deputies, and the engine man mentioned by me, and Dransart's timbermen, are instances. The essential point to be grasped, is that the Nystagmus is produced by fatigue of the elevators and the internal and external recti muscles, and any work capable of bringing about this fatigue will also be liable to occasion Nystagmus. The more the work calls into play the position of the eyes, which has already been set forth in detail, the more frequent will be the Nystagmus, and the more severe its character. The "holers" are thus specially prone to this malady, and the less

* The differences in this respect in other localities is shown in the following extract from a letter in the "Times" of December 8th, 1891, from Mr. Nixon, a gentleman with experience in both districts alluded to: "In Durham, where the coal is worked principally by 'board and pillar,' the hewers confine their services simply to the getting of the coal, while the repairing and timbering is done by deputies; whereas in South Wales where 'Long-wall' prevails, the hewers have not only to cut and fill their coal, but they have also to put up their timbers, cogs, gob-walls, and lay their roads; and in by far the greater number of cases, in consequence of the dangerous roofs under which the steam-coals lie, a considerable proportion of the hewers' time is taken up in work of precaution, and for prevention of fall of roof and coal (and for which separate prices are paid)."

such a position is called for in the mine the less frequent and less severe will be the Nystagmus.

A man may, whilst standing and occupying more or less the erect posture, still by the manner of work he performs, place himself in such an attitude that his gaze will be cast for varying periods in a way that fatigue of the inferior oblique and recti muscles will be brought about, and Nystagmus may thus be occasioned. The kind of work called "clodding" (*Fig.* 8) is an example, and the cases described of the "on-setters" illustrate the occurrence of Nystagmus in men occupying a still more erect posture at work.* Dransart mentions Nystagmus as being met with in men working seams of coal two metres thick. He figures them standing at work (*Fig.* 17), but still their eyes are cast in an upward and oblique direction. They suffer less frequently and less severely than the men engaged in the thin seams, where it is necessary for them to work on their sides. On this point he and I are in agreement. It is well also to bear in mind the marked difference of vertical and horizontal pick work. The former has been shown in the case of miners working at "cutting or headings" to be innocuous. The strained position of the muscles mentioned is not occasioned. Examples can be easily multiplied from the workers in other mines. Horizontal pick work and the accompanying direction of the gaze is injurious, and therefore of importance to remember. "Ripping" or getting down roof coal is work that is often complained of. Statements made as to the presence of Nystagmus in thick seams, where it is alleged holing is not much practised, have, it seems to me, been made with an incomplete understanding of the facts just now set forth. Nor have they been verified by personal observation as to how the men actually have worked the coal, and their position whilst engaged at the coal face.

* One of my patients (Case 80) at the time he came to me was working upright at a place seven and a half feet high. He had been a holer.

Fig. 17

ATTITUDE OF THE MINER WORKING IN A SEAM OF COAL 2 METRES HIGH, WHEN HE EXTRACTS THE UPPER QUARTER OF THE SEAM.

(Dr. Dransart's Photograph.)

As a further testimony to the exceptional occurrence of Nystagmus in others than coal-getters, but fulfilling the conditions as to "position," may be mentioned the following case, which Mr. Justin M. McCarthy, of St. George's, Salop, has very kindly brought under my notice.

The man, aged 39, has not been a coal-getter, but he has been in the habit of pushing tubs with his head, and to this he attributed his trouble. Mr. McCarthy adds: "I further elicited that he pushed these tubs 'with his face downwards but turned.' This seems to convey that his eyes were in much the same strained position as in holing."

OBSERVATIONS ON THE WORK IN SOME THIN COAL SEAMS.

I will now refer to an interesting series of observations.* Whilst there is a general agreement as to the kind of work performed in a coal mine in different parts of the country, it is well known that in some parts it will vary considerably. Thus, shortly after the publication of a recent paper of mine in the *British Medical Journal*,† Dr. J. A. Smith, of Middlestown, was good enough to bring to my notice that, whilst in his district safety lamps were universally used, very little "holing" was done, and Nystagmus was seldom met with. The seams were thin and the coal was very soft. In fact, after a residence of two years in the locality, and having to do professionally with 95 per cent. of the colliers, he had met with one marked case only, and that in a man who had done "holing." It was through his kindness (I was not previously acquainted with him) that an opportunity was afforded me, of investigating the conditions of work in these thin seams, and I give the results arrived at.

In the neighbourhood of Wakefield there are several collieries working thin seams, varying in thickness from 24 or even

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* *Vide* also Appendix.

† July 11th, 1891 (vol. ii. p. 61).

22 inches to 32 inches. At my visit to this district, Dr. Smith got together miners working in no less than six of these pits. The manner in which the coal was got differed greatly from that which is usually practised in the thicker seams. The miners in seams 32 or 33 inches thick, worked sitting on a small stool called a "crocket." The height of the working place only corresponded to that of the seam of coal, and therefore, it was necessary for the man thus seated, to have his head turned on one side. The "crockets" were about 4 inches high behind and only 2 inches high in front. A man of average height (5 ft. 7 in. or 5 ft. 8 in.) will, sitting naturally on one of these crockets, be about 37 or 38 inches from the floor to the top of his head. This will give an idea of the slope he must give his head and body to perform his work. There appears to be no actual holing done in these thin seam pits; the rubbish, and in some places the coal, is cleared away with the pick from under the coal seam for a distance of about a foot; the height of this under-cut at the face of the seam being about six inches, and "sprags" or wooden supports are inserted to keep the coal up. This process goes by the name of "bearing," and the coal is subsequently got down by withdrawing the sprags and the use of a pick. About 30 miners were brought together for examination, representing several hundreds employed in the different mines, and several of them demonstrated for us the manner of their work. Seated on a "crocket," the miner inclines on one side, and throws thus the head also on one side. The extent of the side turning will be understood by the statement made above as to the height of an average man, when seated on one of these "crockets." The position will resemble somewhat the first stage in ordinary "holing," with this difference, that if the miner is to remain at the working face he must continue to assume an inclined attitude. The mode of work appears then to be on the whole a less trying one to the eyes, as indeed it seems also to be for the body, than is the ordinary employment of "holing." Conditions are present which may give

rise to Nystagmus, but probably less frequently, and it may be in a less pronounced form, than is the case in pits where thicker seams are worked, and "holing" is extensively adopted. The results of my investigations showed the correctness of Dr. Smith's observation as to the infrequency of Nystagmus in an aggravated form in his district. Twenty-eight miners were got together for examination by me. They were from the different collieries already alluded to, and Dr. Smith said they were rather men who it was thought might possibly suffer from their eyes than otherwise. Inquiry made it at once evident that there was a marked absence of knowledge of the affection among the men. This ignorance of Nystagmus, and of those among their fellows who were afflicted by it, was in strong contrast to the familarity with it, and the sufferers from it, which has been mentioned as existing among the miners investigated in the candle-lighted districts. In the pits under consideration safety lamps were exclusively used. The work in the thin seam pits, those viz., where the coal is 22 or 24 inches thick, is more like that adopted in holing, for the men are obliged to pursue their task lying on one or other of their sides, and Nystagmus will be more frequently found. The instances of Nystagmus met with among those examined were the following:—

1. A man, aged 50, is working now in a pit where the seam is 32 or 33 inches thick, and he sits on a "crocket" at work. He is using a Clanny lamp now and has done so for three years but previously to this he employed a Davy. He has no definite symptoms of Nystagmus, and has never been away from work in consequence of it; oscillations are, however, apparent on examining the eyes in the usual manner, and are most pronounced on his looking in an oblique direction, especially to the right. Six years ago he was working in a pit where the seam was only 24 inches thick, and the position assumed at coal-getting was very similar to "holing"; from what he says it would appear that his complaint began then.

2. This man, aged 34, has worked in a pit where holing was done ; now he is engaged working a 24 inch seam. The floor is soft, and he works in the "holing" position, under-cutting the coal for a yard and a half. He has suffered for about two and a half years more or less, and was off work at one time for fourteen weeks ; when he keeps his head straight he is all right. He has done work sitting on a "crocket," and does not think it as trying as the "holing" position. He tried working in a candle lighted pit without benefit.

3. In this case, the oscillations were very ill defined, and could easily have been overlooked ; they were only noticeable on his looking obliquely. He has never been away from the pit for this cause, and there is no complaint of symptoms. The seam he is now working is 36 inches thick, and he sits at work on a "crocket." His age was 45.

4. A man, aged 35 : some faint oscillations were detected, but there was a complete absence of symptoms.

The examination of these miners thus bore out the supposition arrived at from the manner of work, viz., that Nystagmus would be found in these with less frequency and less severity than in those where the coal is got by holing. As a matter of fact, the cases which were found affected were men who were engaged in working the two foot seam, and where, as has been mentioned, in getting the coal it is necessary for the miners to lie on one of their sides.

The next instance is one of interest. It is not included in those examined in this district, but Dr. Smith* kindly brought the patient under my notice, as it had had much to do with showing him that the main factor in causing Miners' Nystagmus was the peculiar position assumed by the colliers at their work.

G. L. M. was aged 34, and had been engaged in coal mines for 14 years. Latterly he has been employed in this district in a pit,

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* *British Medical Journal*, 1891, vol. ii. p. 476.

working a seam 33 inches thick. Last year he was away from work for a week; he was then engaged at a colliery, working the Barnsley bed, the seam being 4 feet thick. Then he did regular "holing" and worked underneath the coal; he remained at this pit for a year and nine months. Previously to this he had been employed in a mine near Bradford, where he worked lying on his side; the seam was only 15 inches thick, and the coal could not otherwise be worked. Before he did work necessitating a position on his side, he asserts that he was all right. He much prefers working as he is doing now on a "crocket." The Nystagmus is by no means very evident to casual observation, but let the man assume his attitude at work in "holing," and the oscillations will at once become marked. He can, moreover, himself readily demonstrate the ocular movements by throwing his head on one side and turning his eyes obliquely.

Chapter IV.

ON TORTICOLLIS, AND SOME OTHER CONDITIONS ASSOCIATED WITH MINERS' NYSTAGMUS.

It may, perhaps, be well to say something here as to some symptoms and conditions present in cases of Nystagmus, and which bear somewhat upon and support the position theory. Mention has been already made of some of the conditions alluded to, but now they will be considered together. Amongst the series of cases are three who became worse after changing their work to a kind which has been pointed out as prejudicial, and there are three more who volunteered the statement that it was their having gone to "hole" that had rendered them bad. One of these had no longer been able to work on the side that he was accustomed to, and to continue his employment he had changed to working on the other side. Thirteen cases were worse as to the ocular movements on looking to one side, indicating, as has been pointed out, the side on which the patient was most accustomed to do his work. There is evidence of at least thirteen* instances receiving benefit by relinquishing work which has been mentioned as injurious for other employment in the mine. This number is out of the 113 patients among the 127 cases of which records are given. This point will, however, be referred to again when discussing treatment. It is by no means infrequent to observe associated with Miners' Nystagmus muscular tremors, which will be

* The actual number, including cases since this was written, is a good deal in excess of that here mentioned.

recognised as connected with the constrained and cramped position the miner's work requires. Trembling of the hands and quivering of the eye-lids, tremors of the head and muscles of the neck are often met with. If the quivering of the head is not very obvious, a little careful watching will demonstrate slight nodding-like movements, or the hand placed on the head will perceive the motions. Many miners, when at work, move the head as they swing the pick. An interesting case, illustrating the effect unusual muscular action can exert upon the neck muscles, was exemplified in a patient shown at the Midland Medical Society* recently by the President (Mr. Messiter). The man suffered from Scrivener's palsy in the muscles of the neck. He had been in the habit of writing with a pen held in his mouth. He wrote in this way a good legible hand, and followed the occupation of a clerk, but latterly the muscles of his neck commenced to fail and he had to discontinue the practice.

A case of spasmodic torticollis, associated with Nystagmus, a short time since came under my notice. He was a patient in the medical wards of the infirmary, under the care of my friend, Dr. Dyson. The patient, G.N. (Case 67), was aged 36, and had worked in collieries for about 18 years. He had been in several different pits, and had used both safety lamps and naked lights (candles) at various times; for the last twelve years or so he has been employing safety lamps. He appears to have first suffered from his eyes about five or six years ago, when he noticed the lights and objects dancing, but he had never been obliged to cease working for that reason. When first employed in a pit he was a "filler," and then he went to get coal. He has been a stall-man doing holing and other work. He used to "hole" as much as seven feet under the coal. He first felt his neck affected four years ago; when he was occupied in "holing" he noticed that it began to twitch. This passed off. Two years ago he sustained

* *British Medical Journal*, 1891 vol. i. p. 122.

an injury to one of his knees, and had to relinquish his work in consequence, and it was then that he observed the neck affected again. The Nystagmus, not very marked at the period of his first admission to the Infirmary, was still less so at the time these notes were taken. Dr. Rhodes, house surgeon, has kindly given me the following particulars. "When left to itself the head is rotated to the right side and drawn backwards, so that the face is looking upwards and to the right, and the occiput is approximated to the left shoulder. The left sterno-mastoid muscle is felt to be shortened and hard, in a state of rigid contraction, and the upper part of the left trapezius is also rigid. These muscles on the right side are unaffected. When the chin is gently steadied by the right hand the head can slowly but waveringly be brought round to the front again, and can be kept there as long as it is steadied by the hand, but more easily if the gaze is directed upwards. If this control be removed, the position may be retained for a second or two by an obvious effort, but as soon as this is relaxed the head is at once jerked over as before. The muscles chiefly affected are, (1) the left sterno-mastoid, by which the head is drawn towards the left shoulder and rotated round to the right, (2) the occipital part of the left trapezius, by which the head is drawn backwards and towards the left shoulder."

This case is interesting, not only for the association of the torticollis with Miners' Nystagmus, but because the muscles implicated add force to the contention set forth in these pages as to the position in which the head is placed during the process of holing.

Professor Annandale has recorded* a case which is of interest in connection with the one just mentioned. The patient was a young woman, aged 24. She had been employed in a power-loom factory where, in order to follow the movements of a shuttle, it was necessary for her to keep continually turning her

* *Lancet*, 1879, vol. i. p. 355.

head from side to side, and as the handle of the machine at which she worked was at her left side, she had occasion to turn most frequently in that direction. After a spell of unusually hard work the patient began to experience a constant sensation of discomfort and uneasiness in the neck, accompanied by occasional twitching movements. The head seemed drawn somewhat towards the left side, and on moving it the patient found that additional effort was required to subdue the jerking movements, which tended to return it to its former position. The rotation of the head towards the left soon became more marked, and the spasmodic movements increased in violence and frequency. It was observed that while at rest the head assumed the position of rotation to the left and was depressed towards the left shoulder. She was generally to be seen sitting with her chin supported on her left hand, looking over her left shoulder. Any movement from this position at once excited the spasmodic movements. These consisted in a series of jerks becoming more violent as they lasted, by which the head was brought round to the left from any position of rotation towards the right.

After discussing the groups of muscles involved the account proceeds: "The case seemed to be one in which over-work had induced a state of, as has been designated by Dr. Poore, 'chronic fatigue or irritable weakness' in at least two opposing groups of muscles, those most used by the patient, as a result of which they had become liable to spasmodic action. The most certain means of inducing the clonic spasms was any attempt to perform the habitual movement, in other words, to use either group of affected muscles."

My colleague, Dr. Cocking, has also, at the present time, under his care at the General Infirmary a most interesting case, which may be related in connection with those just mentioned. It is a case of what may be called double torticollis, and with it is associated a shaking of one arm. The patient is a miner, aged

48, who has been employed as a coal-getter, and has done a lot of "holing" and "timbering." He complains now of "shaking of the head" of about three months' duration before coming to the Infirmary. The movements come on in attacks, which last for from half-a-minute to three minutes, with intervals of freedom of a few moments to half-an-hour. About nine months before the "head-shaking" commenced he was troubled with a spasmodic affection of the left arm, in which the hand would suddenly open whilst working with the pick, causing him to relax his grasp. The head movements consist of very rapid and rhythmical oscillations from side to side of short range. At first sight the man looks as if he was shivering from cold. The head is held stiffly during the attacks, and very slightly inclined forwards. The oscillations of head are readily induced when he assumes the holing posture, and in that case are far more extensive and energetic. There is Nystagmus well-marked, and answering to the usual indications. An interesting point to note is that the ocular oscillations are most marked on turning the eyes up and to the left; in the same way the head movements become more pronounced on turning the head to the left. The man at once answers our inquiry as to whether he does not do his work mostly lying on the right side by an affirmative. Mention has also been made of the spasmodic affection from which he had suffered in the left arm; and of this it may be said that the right or under-lying arm rested at his work on the floor, and therefore was more supported than the left which was free, and had indeed to do most of the striking work. He has been employed in a coal mine for close upon forty years, and until the last year he always worked with naked lights (candles). The Nystagmus arose when working with candles. He works a thin seam, and does "timbering" kneeling.

This is not the place to discuss the many interesting points in connection with these cases. Attention is, however, asked to the conditions arising in other muscles as the result of chronic

fatigue, in the same class of workmen, and their close similarity to the oscillations of eyeballs, the consequence, it is contended, of weariness in the ocular elevators.

I am indebted to Dr. Landolt for kindly sending me a paper* of his on Ocular Torticollis. It possesses some interest here, for in the two cases which he relates under the title I have just given, the torticollis was held to have arisen as a result of the tilting of the head consequent on efforts to avoid the double images associated with paralysis of the superior oblique muscle on one side. Landolt alludes to similar cases recorded by Wadsworth and Risley, in America, and by Cuignet, in France; in some of the cases mentioned (Wadsworth, Risley) surgical treatment of the strabismus had been attended with good results.

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* *Le Bulletin Medical*, 1890, p. 573.

Chapter V.

PROGNOSIS AND TREATMENT.

The prognosis of Miners' Nystagmus may be regarded as distinctly favourable. Remove the patient from his injurious surroundings and recovery will generally be effected, sometimes quickly, sometimes more slowly, according to the nature of the case. The question of prognosis is, however, mixed up a good deal with that of treatment. On this latter subject it will be necessary to enter at some length. A man's habits should be inquired into. Among the earlier writers on this malady of miners, the abuse of alcohol was held to occupy a prominent place in causation. From the different standpoint as to cause set forth in these pages, the correction of abuse in this respect may also be urged. Tonics like nux vomica or strychnia, or in some cases, iron, or again sedatives like the bromides, appear to render aid medicinally. Electricity has also been used with benefit, it is alleged, by some surgeons. All these different means are, however, auxiliary only to the important one of the relation of the patient to his employment. The matter of prime moment is the cessation from, or alteration of his work. It has been pointed out before, that all the miners in whose eyes oscillatory motions are noticed do not complain of discomfort ; but in those cases where the sufferer seeks medical aid it will be in consequence of the presence of more or less distressing symptoms. Rest from work is then of course required ; in fact, before coming under observation the patient has generally been compelled by the giddiness, headache, etc., occasioned by his occupation to relinquish it. It has, perhaps, been a tolerably general practice, after a period of rest, to advise the patient to seek some work out of the pit, either

on the bank, or to obtain another occupation. This was my own custom, and to my knowledge it was followed by others. It answered well, for the miner was taken completely away from the injurious circumstances associated with his work underground. The men themselves sometimes objected, as the money they could earn in other ways was less. This advice was, moreover, given by me mostly at a time when the part played by position at work in causing the disorder was less recognised, and when I was more inclined, with the miners themselves, to look with greater prejudice than at present on the "safety lamps." Further experience has taught me that leaving the pit altogether is in many cases unnecessary. Stress is particularly laid upon this. Included among the series of cases which have been dealt with, 127 in number, or more correctly 113, because 14 were not patients but were examined at the special inquiry as to naked lights, will be found cases which will show that a change of work underground has been accompanied by improvement, and that the men have been enabled to continue to be employed in the pit. All that has been necessary is that any employment causing a constrained position, such as holing, should be discontinued; and the safety lamps have been used as before.

The following case is one of special interest, and bears particularly on the point just mentioned.

W. B. (Case 85) came to me at the Infirmary on November 11th, 1890. He has worked in the pit for twenty years, and has used safety lamps for fourteen years. He has been suffering from symptoms for about the last two or three months; quite recently he became worse, and was compelled to leave his work, and, thereupon, applied to me. He was similarly afflicted five years ago, and was under my care then, and recovered. On my advice he obtained work outside the pit. He continued at this for twelve months, and then went into the pit again and was occupied in looking after the roads and ponies. Then for six months he did getting down the coal after it had been holed by

others, and removing the "sprags" or wood supports. He did all this, be it remembered, with safety lamps without finding it, as he says, trying to his eyes. He thought he might then return to his old occupation of holing, and in four months' time he was compelled to leave his work and again seek my aid, and this notwithstanding a respite of nearly five years since he had done holing before. The ocular movements were now, as on the first occasion, very rapid; and giddiness and other symptoms were well marked. It was a more than usually bad instance of the disorder. By treatment, at first at my hands and then at the medical side of the Infirmary, under my friend Dr. Cocking (for he had also cardiac disease), he has again made a most satisfactory recovery. He will soon be fit, if he wishes it, to obtain employment underground again, but he will *not do holing*.

This case is, in my opinion, most important, and it lends strong support to the views as to the cause of the disorder, which have been set forth. For the man got better by ceasing from the work which is maintained to be mainly responsible for occasioning the disorder; and pursued other work in the pit with safety lamps for three years and a half without discomfort; but on returning to "holing" the symptoms recur very speedily, and it appears as a direct result of the resumption of work in such a constrained position. When five years ago the man first came under notice he was a "lamp man." Is it to be wondered at that he has altered his opinion, and now believes that to the position necessitated in holing is to be attributed his disorder?

It is unnecessary to enter into detail as to other cases; they are hardly so striking as the one just related. They, however, point the same way, that a discontinuance of the prejudicial work allows a man to remain employed underground at the same time that he is exposed as formerly to the *same conditions as to illumination*, viz., the use of *safety lamps*.

One of the most recent cases is that of which my friend Dr. Scott writes: "S. has changed his occupation to "dataling"; he

lays down rails for trams and, although he is working in quite as bad a light, ordinary safety lamps, still his eyes are not so bad."

Another patient now under observation has given up coal-getting and is getting the "stuff to the pit bottom" and is acting as "corporal" in looking after the tram boys. A further case quite recently under my care had been already advised by his medical attendant (Dr. Cheesewright), that he should "keep his head straight at his work," and has therefore gone back to "stone work" in the pit. The change to other employment underground has in both of these last mentioned instances been satisfactory.

One of the deputies, whose case has been described, has found he has been able to pursue his work with more comfort by throwing his head back, and avoiding as much as possible the upward and oblique turn of his eyes, when examining the roof, etc.

Just at the time of writing, the man, whose photograph is given (*Fig.* 9) in the attitude for "holing," has again been seen by me. He had recovered, and shortly after the photograph (in 1884) was taken had passed from under my observation. Now an opportunity of finding out where he was presented itself, and he was desired to call upon me. He was perfectly free from the disorder. After working at gardening, and selling his produce with a pony and cart, he obtained employment on the pit bank; at first by day only, but afterwards by night, in alternate weeks. He has for the last ten months resumed work in the pit. He gives a curious reason for thinking he might do so. It appears that at night he worked on the pit bank by means of the electric light, and he says, he thought if he could manage these lights he could certainly work with the "lamps" in the pit. He has been engaged underground for the time stated, and has got on well up to the present. His work has been at the coal face, getting the coal down after it has been "holed" by others, and making the coal ready for sending to the pit bottom.

He is fully alive to the importance of not doing "holing."

Among more recent cases since the tabulated series was prepared are others giving the same indications as to the advantages accruing from an alteration of pit work. At the same time it is important in advising any particular manner of work in place of the accustomed one, to be sure that it is one that may with advantage be substituted. This is of the utmost importance even if the altered work be done above ground in daylight, as the following case, which has quite recently come before me, amply testifies.

The patient was a man, aged 27, who had worked as a coal-getter, doing "holing," etc. He had suffered from symptoms of Nystagmus for about eighteen months, and had been advised by a medical man to leave the pit and obtain work above ground. This accordingly he did, and discontinued his employment in the mine in May, 1891. He sought my advice in the November (1891) because he was still suffering so much that it was with difficulty that he was able to continue any work at all. Inquiry disclosed that the employment he was engaged in was filling wagons on the pit bank, and that to do this he was constantly shovelling the coal from a platform into the wagons, which were placed on a much higher level. Now it has been pointed out in the earlier part of this volume, when discussing the symptoms and nature of Nystagmus, that one of the means of provoking a display of the ocular movements was by lowering and rapidly raising the head. The work he was now engaged in had practically the same effect, and though working in broad daylight, he had failed to be benefited by a change of work. He was recommended to make a further change, and the kind of employment that he might hope to do, with perhaps impunity, was explained to him. As the result of my suggestion he took to "tipping" or unloading the "corves," and as this was employment that kept his eyes below the horizontal

line for the most part, it was well suited to his condition. This work he has been able to manage with comfort.

At the time of writing some weeks have elapsed since the advice was given, and the man has attended on several occasions, and has made very satisfactory progress as far as the ocular disorder is concerned.

Chapter VI.

PREVENTION.

It may perhaps be asked, Do you suggest any remedial measures which may obviate or lessen the frequency of the malady to which it has been shown the coal miner is prone? The conditions by which, in my opinion, the affection is occasioned, as well as the favourable results attending treatment, based on such views as to the cause, have been pointed out. How to meet and overcome the injurious influences which have been mentioned, is perhaps more a question for the mine expert than the surgeon. Information has been sought and inquiries made however, of authorities who would be best able to aid one on this subject. The points for consideration are, of course, the mode of work, and the lighting of mines.

1. The kind of work performed by the miner, and particularly the variety called "holing," having been mentioned as so injurious to many, it becomes important to know if any means can be adopted to render such work either unnecessary or less frequently required. I am afraid my inquiries do not help us very far. In the working of most of the coal seams in perhaps almost all parts some such process as that which has been described as "holing" will be necessary. Coal-cutting machines have been invented to effect the end in view, instead of by manual labour. Several such machines have been devised, but it is needless to specify them here. A coal-cutting machine will cut under the coal for from two feet to four feet; a man following the machine and propping the undermined coal with "wooden sprags," the hole under which will be only a few inches high. A machine like this will be worked by compressed air or by electricity,

and will do the work of several men. These machines do not appear to be at all extensively used; some of the collieries in my district employ them. Mr. T. Forster Brown, at the recent meeting of the British Association (1891), thus spoke of these machines: "In some of our coal-fields very hard seams or veins of coal are met with, and various kinds of machinery have been devised, to assist the coal-hewer in severing the coal from the solid strata, and electrical appliances have in this class of machinery been more or less successful. It appears to me, however, that there is a want of simplicity about the majority of the machines which have come under my notice which will operate against their general adoption."

The following extract from a paper by Mr. Emerson Bainbridge read at the meeting of the Institution of Mechanical Engineers at Sheffield in July, 1890, is of interest, as bearing also on this subject.

"Very little progress has been made during the last twenty years in the replacement of manual labour by machinery for the getting or hewing of coal. It was thought at first that such machinery would be economical only in the case of coal seams which were both hard and thin, but experience has shown that the only two conditions which are imperative are a fairly strong coal and a good roof. Without going into details as to the merits of various systems it may be sufficient to mention that at a colliery in South Yorkshire, with which the writer is connected, about 700 tons of coal a day are worked by a rotatory machine, the design of which has been arrived at as the result of many years' experience. The first cost of a coal-cutting plant, including air compressor, pipes and coal-cutting machine to cut about 300 tons a day, is about £3,500. There is a distinct saving of labour in the use of the machine, but this has not as yet been advantageous to the coal owner; the chief advantages are that a larger quantity of round coal is produced, and the most arduous and therefore the most expensive part of

a collier's work is done by machinery. Coal-cutting machines driven by electric motors are not uncommon in America, but have only recently been adopted in England. One is at work at a colliery near Leeds. A comparison of this system with the machine driven by compressed air does not appear to show any advantage. The employment of machinery to deal with the more arduous portions of the miners' work becomes yearly of more importance; and whilst the undercutting of the coal can now be done extensively by mechanical means so the drilling of holes in coal and stone, which was formerly done entirely by hand by means of percussion drills is now performed by mechanical drills."

The use of explosives in the coal-pit is a means also of mitigating the miners' labour. Modern invention tends to make their employment less dangerous. On this point I will also quote from Mr. Brown's address. He says, "Much attention in modern times has been given to the relative values of the numerous new explosives which have been introduced for blasting in mines, and for other purposes. Sir Frederick Abel is the greatest authority on this subject. As applied to mining, various experiments have from time to time been made for the purpose of testing how far it would be safe to employ these explosives in the atmosphere of a coal mine without risk of causing an explosion of fire-damp. A number of these are mainly composed of compounds of nitro-glycerine with aluminous earth. But whilst the experiments have indicated that with rare exceptions they are practically flameless, it is undoubted that one which would be absolutely so, and which could be used with safety in fiery mines has yet to be produced."

2. The second point appears more capable of, at all events, earlier improvement. In the first part of this volume reference was made to the improved light-giving qualities of modern safety-lamps. The report of the Royal Commissioners on Accidents in Mines, in 1886, testifies to this. Still the lighting

of coal-mines, better than formerly, as it undoubtedly is, does not come up to what it should be, and things are pointing in a direction to indicate further improvements before long. New safety-lamps are frequently being devised, and increased light-giving is an element in all of these, second hardly to safety. Much has been hoped from electricity, and much is still expected from it in the future. There does not appear to have been much advance in lighting by this means during the last four or five years. In portable electric lamps a difficulty has always been in the frequent renewal that the battery requires, and the cost of using them constantly would at present be so great as to be prohibitive. Fixed electric lighting is more coming into use for the lighting of stations, but not for the working faces in consequence of the inconvenience and possible danger attending injury to the wires. A great advantage an electric lamp possesses over an oil lamp is in the question of safety; no communication with the external air is necessary. Mr. Rhodes, whose work in connection with the last Royal Commission is so well known, tells me that if he could get a really satisfactory electric lamp he should prefer it to others because of its safety. In lamps which are taken to pieces and cleaned every day there always must be some risk of something being wrong, and it seems to me quite evident that it will be by means of electricity that the better lighting of coal mines in the future will be effected. Professor Sylvanus Thompson, at the recent British Association Meeting, urged that the use of electric lamps in fiery mines should be compulsory.

Besides all this there is at the present time a movement leading to the production of protected oil lamps of improved illuminating power. During the preparation of this book several safety lamps have been brought under my notice, and the tendency is, as just mentioned, to better light-giving powers. The best light given by an oil lamp that has come before

me is that afforded by the Thornebury. The makers assert that it meets the conditions laid down as essential for an efficient miners' safety lamp by the Royal Commissioners appointed to inquire into Accidents in Mines in their Report in 1886. Through the kindness of Mr. C. E. Rhodes an opportunity has been afforded me of witnessing some tests applied to this lamp and others, and it is clear that whilst there has been the improvement in illuminating power, it has also been accompanied by increase in safety. It should be added that it is much heavier and more cumbersome than an ordinary safety lamp, and burns a mineral oil, which, in the opinion of some, is objectionable. This lamp immediately becomes extinguished in an explosive mixture of fire-damp and air.

Another recent improvement is the introduction of enamelled reflector glasses. One-third of the safety lamp glass is enamelled white; the enamel is burnt on the glass, so that it cannot be removed, nor can it lose its colour. A lamp provided with a glass of this kind will occasion much less glare when it is carried or placed in front of a miner. In my opinion it is a valuable invention.

The need for the better lighting of coal mines is generally admitted, and from what has been said, it will be understood that the demand is to some extent being met. The manner of illumination aiding only in a secondary way in the production of Miners' Nystagmus, improvements in the direction indicated will not abolish the malady, but they will certainly render the miner's lot more comfortable at his work, and, it may be, make less frequent the disorder.

Chapter VII.

NYSTAGMUS: IN RELATION TO OTHER OCCUPATIONS AND KINDS OF MINING.

COMPOSITORS, DECORATORS, ETC.

The kind of work performed in a coal mine is peculiar. The character of the seams and the coal formation makes this so, and the prevalence of gas renders impossible the free employment of explosives, as is the case in metalliferous mines. It is, however, I think, clear that if similar conditions as to position at work which have been shown to act injuriously to the coal miner be present in other occupations, that Nystagmus will also be found to occur. The case of the compositor to which allusion has already been made testifies to this. In the Appendix will be found the paper in its entirety, which was read before the Ophthalmological Society relating this case and containing remarks upon it. It will therefore be sufficient now to refer to it very briefly. The Nystagmus was vertical in character, and complaint was made of the objects moving in an up-and-down manner. It was shown by investigation of the youth at his work that in looking up at his copy he raised his eyes only and not his head at the same time, that fatigue (and consequent Nystagmus) had been induced in the upper recti muscles. This case is interesting, and it is important, for it indicates the likelihood of Nystagmus occurring as the result of chronic fatigue in other occupations than that of the miner. Quite recently another compositor has been under my care, not with Nystagmus, but with fatigue of the elevators of the eyes, and it is well worth mentioning in connection with the one just now alluded to. He was also employed

at a newspaper office. About twelve years ago, he tells me, that I operated upon him for squint. The result now is excellent. He complains of his eyes tiring after work and of headache at the top and back part of his head. The eyeballs ache and movement of the globes upward is attended with decided discomfort. His hours of work have been from about 7 p.m. to 1 or 2 a.m. but the time varies. The aching of eyeballs remained until the next day. This seemed to me a case in which weariness of the elevators had arisen but had not advanced to Nystagmus as in the former instance. His spectacles were not correct and they were changed (R=6/60 no glass improves ; L. sp. +1. 25 c cyl. +1D=6/6). Those ordered were comfortable. I determined to see him engaged at his work. One night, therefore, in company with Dr. Burgess I visited the newspaper office. Like the other compositor he was throwing his eyes up to the copy, instead of raising his head. He had admitted that this was so before. We now watched the other compositors who were engaged in the same room and this casting up of the eyes was not the rule among them. One man told us, when asked, that his eyes would soon tire if he did it. Dr. Burgess was also satisfied that there was occasion in the way we saw his work done for the eye strain spoken of. Another interesting point of analogy with the other compositor is in the hand affection. The man has also suffered from what may be regarded as early evidences of a tendency at all events to compositor's cramp. For two months before coming to me he had had slight pains in the first two fingers of the right hand, but with no cramp. He was directed that he should at his work for the future raise his head with his eyes. This he has acted upon and he tells me after a lapse of two months that he is doing his work with comfort and that he feels much better than he has done for a long time.

Another case should here be mentioned which came under my notice a short time before the last related one. He was a

lad aged seventeen. His vision was normal, but he came to the Infirmary complaining of pain and other symptoms just as in the last case, indicating weariness of the elevator muscles; there was no Nystagmus. This lad was employed at a large confectionery factory. Among other things his work consisted for about three hours every afternoon of carrying a tray about 3 feet 6 inches to 4 feet long on the top of his head filled with sweetmeats, and mounting with it up several steps and then passing it on to a shelf. He brought us one of these trays and mounted it on his head as he would do at his work. The length of the tray caused it to project when balanced considerably in front of him, and to see that it was all right he directed his eyes to the tray a great deal. It was of importance to see how he carried himself when actually at his work. Dr. Cocking very kindly went with me to investigate his mode of work more thoroughly. In the presence of his employer and of some of the work people with whom he was engaged he went through several times the kind of work he actually performed daily. He carried the tray on his head and mounted the steps to shunt it off on to the ledge, turning his eyes obliquely as he did it. In our opinion there was ample cause for the strain from which he was suffering. The way he cast his eyes did not appear to be altogether necessary, and a man more practised and who could better balance the tray would not place his eyes as this lad did. I heard that he soon sought some other employment, but he told me that another youth some time before had also been unable to continue at this work.

These cases are of interest and value in connection with the instance of Nystagmus occurring in a compositor to which allusion has been made. Investigation will in the future I believe show similar cases in connection with other kinds of work. This is not the place to enter properly into the subject, but it appears to me that a main factor also in the causation of Academy or Sightseer's Headache is the weariness of the ocular

elevators induced by so often throwing the gaze upwards above the horizontal line and frequently without a corresponding up-turning of the head.

The decorators and painters of ceilings have been suggested as a class of workmen who might be afflicted with Nystagmus. An occasional case may perhaps at some time be met with as in the compositor, in one who has performed his work in a more strained manner than is usual, and brought himself more under conditions similar to those which have been shown to be prejudicial to the miner. As far as my inquiries have extended, however, it seems that though these decorators work with the head thrown back and the eyes directed to the ceiling, the point to which their gaze is turned is in advance of them. There is no oblique movement of eyeballs, nor is the direction of the gaze in such a way as to cause fatigue of the upper recti muscles as was the case with the compositor. An experienced decorator of whom I just now made inquiries said "it is not in our eyes that we feel strain but in the neck, from keeping our heads thrown back."

OTHER KINDS OF MINING; CORNISH MINES.

There is not, as far as I am aware, any evidence pointing to the occurrence of Nystagmus in other miners than those engaged in coal pits. For years it has been my custom to make inquiries of any colliers who have come to me and have had experience of other kinds of mining, as to the kind of work they have had to perform in these other mines. Men from whom these inquiries have been made have acquired a knowledge by actually working in them, of mines in not only the United Kingdom, but in America, the Colonies, and I think on the Continent. It is not intended to give the impression that such information is complete, but it indicates that an absence of Nystagmus coincides with an absence also of the coal miners' characteristic work.

There is, however, one kind of mining that I am able to speak of from personal observation. It is recognised, I think, that the Cornish miners do not suffer from Nystagmus. The late Dr. Hudson, of Redruth, at a discussion at the Ophthalmological Society * in 1882 on Miners' Nystagmus, contributed the interesting observation that although he had a very large experience of Cornish miners he had never met with Miners' Nystagmus, except in men who had acquired it whilst working in coal mines in the north. In one such case the Nystagmus entirely disappeared in less than twelve months after the man took up his abode in Cornwall. Dr. Hudson stated that the Cornish miners never worked more than eight hours at a shift and often less, so that they undergo no more abnormal straining of the eyes than ordinary persons who sit up for a few hours at night.

My friend Mr. Gidley Derry, of Bodmin, writing to me some time back says, "From inquiry I find that Cornish miners do not suffer from Nystagmus, nor do they work in the same position as coal miners."

There was thus distinct evidence not only that Nystagmus was absent in the Cornish miners, but that their mode of work was different from that done by the coal miner. I decided to investigate the matter for myself by a personal visit as I had done in the case of coal mines, and to see for myself the interior of a Cornish mine and the men actually engaged at their employment, and the manner in which they did their work. Mr. A. E. Pinching, H.M. Inspector of Mines for the Devon and Cornwall District, informed me before my visit that in his opinion I should find no Nystagmus in the mines in Cornwall. I am much indebted to him for not only making all arrangements for my visit, so that it should be as profitable for my purpose as possible, but for personally accompanying me into

* Trans. Ophth. Soc., 1882, p. 250.

the mine, and for giving me much valuable information. The mine visited may be regarded as fairly typical of those in Cornwall, and I give the account of the inspection as it was written out and corrected almost immediately after. It will be noticed that the Cornish miner works with a candle of the size of twelve to the pound, whilst the coal miner in Derbyshire using naked lights employs candles sixteen or eighteen to the pound, and the illumination in the Cornish mines is correspondingly better.

VISIT TO A CORNISH MINE, AUGUST 3, 1891.

On the date above given Mr. A. E. Pinching, H.M. Inspector of Mines was good enough to accompany me on a visit to a mine near Callington, the object of my inspection being to ascertain by actual personal observation the manner in which the Cornish miners were engaged at their work. The mine visited was one of three belonging to the same company. It was a mine being worked for arsenic and copper, the ore being arsenical pyrites. The mine was worked practically by two shifts of eight hours each, but a few of the men were employed in a third shift. Our visit was at two o'clock, when the shift was changed. This mine, as is the case in all Cornish mines, is worked with candles: twelve to the pound are the size used by the miners, but the captain's candle is larger, being of the size of eight to the pound. Besides information kindly afforded me by Mr. Pinching, I had also the good fortune to be received at the mine by the secretary to the company and by Captain B. the manager of the mine. The latter had had an experience of Cornish mines for something like forty-six years; he was quite unacquainted with such a disorder as Nystagmus, or indeed of any special eye complaint to which the miners in those parts were subject. In this mine there were employed under ground one hundred and five men, ninety being miners or "stopers" as they are called; eleven trammers and four fillers. The total

employed by this company underground in this and the adjacent mines would be about three hundred. Twenty-one of the miners in this mine presented themselves for me to examine their eyes. There was not only an entire absence of Nystagmus amongst them, but an utter want of knowledge of such an affection. None appeared to have at any time observed the lights dancing whilst at work in the mine, nor to be acquainted with any miners who had at any time made such a complaint. Some, at all events, struck me as being less healthy looking* than coal miners generally appear. Two of the miners examined had been at one time employed in coal pits. Thomas F., a Cornishman, aged 48, had worked twenty-five years ago in the New Brampton Colliery near Chesterfield, and for five or six months did holing; he used safety lamps. He had also been engaged in coal mines in America, and in working the Anthracite coal in South Wales; he did holing there too. He has no Nystagmus. He speaks of the thoroughly different kind of work in a Cornish mine. The other man was aged 33, and twelve years ago he worked in a coal pit in Durham for eleven months; he did holing. In addition one of the captains (or deputies, as they would be called in a coal mine), had been at work in a coal pit, and

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* Dr. Ogle in his paper before the International Congress on Hygiene to which reference has already been made, mentions the comparative mortality in this way. Taking clergymen, the healthiest of all, at 100 for comparison, the collier would stand at 160 and the Cornish miner at 331; again, for deaths from respiratory diseases the coal miner is stated at 166 and the Cornish miner at 580. In connection with the foregoing the following extract is of interest: "The metal worker is, however, less fortunate than the collier, if the underground work be regarded from a hygienic point of view. From the effects of climbing, of working in air deficient in oxygen, and having an excess of carbonic acid, the average duration of a miner's life in the deep mines of Cornwall or in the lead mines of the Mountain limestone districts of the North of England is reduced to about 32 years. ("Underground Life, or Mines and Miners," by L. Simonin, adapted and edited by H. W. Bristow.)

he much preferred a Cornish mine "because there was no need for so much stooping."

The next thing was to descend the mine. Two captains accompanied Mr. Pinching and myself. We were supplied with the captains' candles, being 8 to the pound. They were surrounded with clay, and were carried in the hand, except when any climbing was necessary, and then we fixed them by means of the clay to our hats. We descended in a "gig" or small cage. In many of the Cornish mines the only mode of descent or ascent is by means of ladders which the men have to climb as they go to or come from their work. The mine was 215 fathoms deep at the lowest part from the surface. We descended 195 fathoms. We passed along the levels, which had been made out of the solid rock by a boring machine, to reach the workings. There was not much difference in the light of the place, except the walls had a less black look than in a coal mine. The men at work on the lode, and the sort of place they worked in, were the points of most particular interest. The miners working at the lode are called "stopers," and the place at which they are working is named a "stope." The miners work generally with the candle stuck in their hat or against the wall. The "stope" is of such a height that a man can work standing perfectly upright; in some mines the places are very lofty and large. It is the intention so to arrange these stopes that the men shall be able to work at the lode upright. There is only comparatively a trifling amount of pick work done or indeed required. Explosives are extensively used, and the lode stuff (mundic) is separated by wedging and by bars. There is no occasion for horizontal pick work or any such manner of work as holing. The men work up the lode throwing the waste down, and this raises them from one level up another. Several men were observed at their work in different stopes. The process of making what was called a "cross cut" was also seen. This consisted in making a straight

drive from one lode to another; but here also the miners were upright at work, and plenty of room was afforded them. The trammers were also observed at their work. Their candle was stuck in front of the truck whilst it was pushed from behind. The mode of despatching the mineral to the surface is quite different to that adopted in a coal mine. Here the "skip" is filled, and then hooked on and drawn up, and an empty one does not descend as the full one goes up; and besides this the frequency of despatch would be very much less than in a coal mine, and thus again the causes occasionally producing Nystagmus in the hangers-on in a coal pit would be less operative.

From all the inquiries I was able to make the conclusion arrived at was, that there was an absence of acquaintance with Nystagmus, in connection with mining in Cornwall; and my personal observations in the mine, as well as all I could learn from officials and men, satisfied me that the causes acting so prejudicially in the case of the coal miner were absent, and that if Nystagmus occurs at all it can be but very extremely rarely.

Chapter VIII.

CONCLUSION.

If the reader has followed my remarks, and weighed the evidence cited, and understood the bearing on the question of the cases which have been related, he will, I hope, have already arrived at the conclusions which will now be set forth.

1. It is impossible to regard the employment of safety lamps in the mine as an essential element in the causation of Nystagmus. Abundant evidence has been adduced of men being afflicted who had never so much as used a safety lamp. Nor can the imperfect illumination of coal mines be accepted as an essential element in causation. For not only has Nystagmus, according to the statements of the advocates of the safety lamp theory, not diminished with the improvements which have been shown to have taken place in the lighting of pits, but the presence of the malady has been demonstrated in men working with naked candles, torches, and in such good circumstances as to light at the pit bottom, that the question of imperfect illumination could have no place. The instance of the compositor has exemplified the occurrence of Nystagmus in ordinary conditions of illumination above ground. Moreover, it has been shown that whilst all in the mine work with the same light, all are not equally subject to Nystagmus. We must, therefore, for the prime and essential cause of Nystagmus look elsewhere.

What part then does the lighting of the mine play? It is a distinctly secondary and non-essential one. It is not a matter either of the employment of safety lamps or naked lights, but one of illumination. Other things as to

the kind of work done being equal, Nystagmus will be found more frequent with the worse form of lighting, and in this way the question of illumination is of secondary importance. This is the opinion held by Dr. Dransart as well as by myself. The worse the light the more will the effects of strain be experienced.

2. The essential and prime cause of Miners' Nystagmus is to be found in the kind of work performed, in which the gaze is directed upwards in a more or less oblique manner, whereby fatigue is induced in the elevator muscles of the eyeball (superior rectus and inferior oblique) and the internal and external recti. Evidence has been advanced as to the manner of work done in the pit by the men who have been afflicted with the disorder; support has been rendered by observations made whilst miners were actually engaged at work in the pit, and the analysis of the tabulated series of cases testifies in the same way. There is moreover a general consensus of opinion amongst observers that the workers prone to be affected are the coal-getters, whilst others employed in the pit are but little subject to it. The symptoms of this particular kind of Nystagmus have been shown to be in accord with such a cause. Turn the gaze above the horizontal line, and especially somewhat obliquely, and the oscillatory movements will be occasioned; direct the look downwards and they will cease. It has been further shown that treatment based on the acceptance of this mode of causation has been eminently satisfactory.

The position of the miner at his work is therefore the prime and essential cause of Miners' Nystagmus.

The cause then of the Nystagmus may be summed up in this way:—It is occasioned by fatigue of the superior rectus, inferior oblique, and internal and external recti muscles, induced as a consequence of the miner's work in the pit necessitating an upward and more or less oblique gaze. It occurs irrespective of the mode of illumination.

APPENDIX.

TABULATED SERIES OF CASES

COAL-

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
1	Oct., 1880	35	James H.	27 years, since age of 8.	1 year.	Mostly on his side (holing) but also cutting straight forward.
2	May, 1877	52	Sydney V.		12 months; worse last 2 or 3 months.	Has worked a great deal on his side; less last few years.
3	Oct., 1880	27	Dearden E.	17 years.	9 months.	Worked on his side (holer).
4	1884	35	H.		For some time: better now.	Used to do holing; now gets coal by cutting straight forward.
5	Feb., 1890	36	Wm. B.	Since a boy.	12 months; worse last few weeks.	Coal-getting and holing.
6	Nov., 1890	42	B. B.	Since a lad.		Holing.
7	June, 1890	42	W. E.			Holing: now stone drifting.
8	May, 1890	41	W. D.	Since age of 9.	Last year or two.	Coal-getter, and has done more holing the last 2 or 3 years; seam 6-ft. thick.
9	Feb., 1888	28	Wm. H.	Since age of 6.	Several months.	Coal-getter and holer: is now filling tubs.

* All these cases were coal-getters and, of course, all suffered from Nystagmus, but additional points as to mentioned. The cases are arranged in a tabular form for convenience, but the notes were not, perhaps in the themselves at the Infirmary; hence they vary in completeness. They are discussed and analysed on pages 43

OF MINERS' NYSTAGMUS.

GETTERS.*

Nature of Symptoms.	Remarks.
Giddiness; oscillations commence at once on his looking up and to right. This is the way he turns at work.	Was learning dancing and had to give it up because he got so giddy.
Oscillations mostly horizontal.	I have no note whether this man employed safety lamps or candles. He came from where a subsequent case used candles.
Oscillations, horizontal, vertical and rotatory; worse on looking up and especially to right.	If he ran after a cricket ball, on stooping to pick it up, his eyes jumped so much he could not see it. Tolerably well when going to work in the morning; worse at work as the day went on.
	He suffered "with his eyes," but for the last year he gave up working on his side, and "got coal" by cutting straight forward, and has improved considerably.
Marked Nystagmus.	He volunteers the statement that his work is the cause. When he works on right side as he always does the eyes tire and the "lamp goes round"—right to left, round and round. Has been working on left side, and is all right: and so he is when working upright. He writes, "when walking in the streets at night, and I have bent my head in the same form, the lights in the windows seem to go round the same as in the pit."
Nystagmus present, but without uncomfortable symptoms. L. Myopia R. Choroiditis $+ 1{\cdot}5$ D $= \frac{20}{200}$.	Has worked abroad in gold and silver mines. He believes there is no kind of mining except coal which requires "holing" to be done.
Myopia R — 4 D L — 5 D Nystagmus not much.	Came for his myopia. He says lamps used to dance and they don't now; he is better. On inquiry, I find he has ceased for some time to "hole," and is doing "stone drifting."
Nystagmus is most marked on looking to left; he has worked on right side.	He volunteered the statement that his work has rendered his eyes afflicted; did not experience anything amiss until he did more holing last 2 or 3 years.
Distinct oscillations. — 7 D $= \frac{6}{6}$ each eye.	Has done regular coal-getting and "holing" for some months: could not continue "holing" as it made him worse, and could not see end of the hole. Has been able to continue working as a filler or loader.

the kind of work done and as to the nature of the symptoms, were in most of them noted at the time and are here majority. taken with a view to publication, but were simply entered on the patients' papers as they presented and onwards. When the contrary is not stated the use of safety lamps may be inferred.

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
10	1884	54	H.	33 years.	Recently worse.	Holing: nothing but holing and getting the coal ready to send to bank.
11	Nov., 1889	38	Joseph G.	17 years.	20 months.	Coal-getting 12 years; has done a lot of holing, especially last 2 years.
12	Jan., 1890	40	James D.			Coal-getter: holing.
13	1879	44	J. C.			Always worked on his side (holing).
14	April, 1881	37	Ephraim L.	18 years.	2 months.	Mostly worked on his side (holing).
15	Dec., 1883	46	Wm. S.	36 years.	10 weeks	Worked on his side—both sides.
16	Feb., 1881	39	John J.	29 years.	3 months.	Does work on his side.
17	Aug., 1879	27	Albert B.	16 years.	7 months.	Works on his side.
18	June, 1881	52	John G.	44 years.	4 or 5 years.	Coal-getter.
19	Sept., 1882	28	Hy. R.	15 years.	Off work 9 weeks.	
20	Aug., 1881	45	Charles L.	37 years.	About 15 months.	Works on his sides as well as forwards.
21	Sept., 1882	38	George B.	30 years.	Some years.	Worked in all positions in the pit (including holing).
22	Dec., 1882	34	Thomas B.		Off work.	
23	Nov., 1880	26	Thomas C.	16 years.	4 years.	Worked standing up, kneeling, and on his side.

Nature of Symptoms.	Remarks.
	Up to 21 years of age he worked in iron-stone mine; since then always in coal and the same kind of seam. Lately, symptoms became worse as he made a change in his work (the man's own explanation), for though he still "holes," while formerly he had 9 inches height of holing to work in now he has 2 feet to get out and clear down, which, he says, necessitates more turning of his head when on his side. Worked with safety lamp before this for 23 years off and on.
Symptoms not prominent.	
	Left; atrophy optic disc; light perception. Right; disc white, V = $\frac{20}{10}$.
Not very bad.	Finds his sight bad when he is upright and striking above him (roof work).
Movements worse in looking up and to right. Well-marked Nystagmus.	
Slight Nystagmus.	Was under treatment before; returned to work and had recurrence of symptoms.
	Came under treatment for abrasion of cornea.
Nystagmus, most evident upwards and obliquely.	R + $\frac{1}{6}$ = $\frac{20}{50}$ L + $\frac{1}{6}$ = $\frac{20}{70}$ (Astig.)
	$\frac{6}{6}$ each eye unaided.
Oscillations: very marked in left eye.	Right eye lost by a burn at 7 months old. Left — $\frac{1}{7}$ = $\frac{20}{50}$.

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
24	Oct., 1877	22	Zaccheus H.	15 years.	12 months.	Has always worked on his side.
25	Nov., 1888	24	Edward E.		Off work.	Coal-getter (holing).
26	Feb., 1890	40	George G.			Coal-getting ; holing.
27	Nov., 1889	29	Frank H.	Since age of 12.	For 12 months gradually creeping on.	Coal-getting and holing ; has also worked in hole made by machine, but in getting coal out this does not prevent him, he says, occupying in some measure the old position.
28	Oct., 1889	41	Charles U.	10 years.		Coal-getting ; he has done a lot of holing.
29	Jan., 1890	34	Henry C.	22 years.	Appears to have suffered 5 or 6 years ago, but is worse now.	Holing ; mostly left side.
30	Dec., 1889	45	Connor P.	25 years.	7 months.	Does holing chiefly ; sits on a stool. "Three years holing in succession."
31	Dec., 1888	40	Edward M.	15 years, began at age 25.	2 years.	Does bank work and holing. He holes every day ; has done so for six years.
32	Jan., 1889	33	Charles H.	23 years.	Some years, last 2½ years worse.	Cutting and holing every day.
33	Sept., 1888	29	Henry T.	18 years.	10 weeks.	Is a coal-getter ; worked at all kinds of work —headings and bank ; done "a deal of holing."

Nature of Symptoms.	Remarks.
Not marked.	
Well-marked case.	In Feb. 1889 he returned to work in pit, but did "datal" work ; found it very different from holing, for with this work he would soon be bad again. In May, no oscillations were visible ; is still working in pit and does not find this trying ; he is as bad out of the pit as in it.
Least marked on looking to left.	
Incipient.	
	He says there are more men who hole now than was formerly the case. He has in consequence of Nystagmus been brought up out of the pit twice during the three weeks preceding his first visit to me.
Nystagmus : worst on looking up and to right.	Trembling hands.
Symptoms present, but Nystagmus not very apparent : looking up and to right suspicious.	
Answers to usual tests ; bending head and looking obliquely.	Works more on right side. Whilst talking to me top of head inclines to right.
	Has had a machine to hole for two years, but still he does holing.

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
34	Dec., 1888	35	Thos. P.			He does "heading," "holing," and "wooding."
35	Oct., 1882	31	Walter H.	20 years.	18 months.	He does a deal of holing.
36	Jan., 1887	46	James R.	23 years.	9 months.	Has done more holing lately.
37	June, 1888	38	Wm. P.	25 years.	3 months.	Holer.
38	May, 1888	34	Wm. L.			Holer.
39	Oct., 1887	48	Sam. S.			Holing.
40	June, 1888	39	Wm. M.			Worked in pit as holer.
41	Jan., 1888	38	Vincent C.			Coal-getter; holing.
42	July, 1888	28	Wm. B.			Holer.
43	Jan., 1886	52	George R.	44 years.	2 years.	Worked at holing 20 years; works sitting on a stool; mostly on right side.
44	Jan., 1886	30	George J.	16 years.	9 days (?)	Been a holer 8 years; works on right side, lying down.
45	Feb., 1888	46	Charles M.	27 years.	2 years.	Has done bank-work and holing 22 years.
46	Nov., 1885	48	Noah G.	40 years.	Eyes failing 3 years.	Has worked with a pick since age 16, holing.
47	Jan., 1886	30	John G.			Done a lot of holing.
48	April, 1886	27	Joseph B.	16 years.		Coal-getting and holing 5 or 6 years.
49	June, 1888	49	John H.	38 years.	1 year.	Holing.

Nature of Symptoms.	Remarks.
A bad case.	Quivering of eyelids.
Slight.	Ordered to give up holing and do other work in the pit.
Not well-marked.	
Slight.	
	Feels worse when he comes down the first thing in the morning.
	Struck on back of head with "prop" 2 years ago.
	Worked with safety lamps for 5 years.
	He did holing up to the time eyes began to suffer; he could not do so any longer.

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
50	April, 1888	34	John S.		12 months.	Is a holer.
51	Jan., 1888	35	James G.			
52	April, 1888	32	Thomas D.			Holer.
53	Feb., 1887	28	James S.	12 years.		Has done a lot of holing.
54	Feb., 1886	36	George L.			Holing.
55	July, 1888	16	Samuel S.			
56	Sept., 1888	29	Henry T.	18 years.	10 weeks.	All sorts of work; heading and bank work and a great deal of holing.
57	Nov., 1886	28	Herbert M.			Miner (coal-getter).
58	Aug., 1887	55	John K.			Miner (coal-getter).
59	Oct., 1888	24	Edward E.			Coal-getting; holing.
60	Dec., 1886	36	Charles B.	20 years.		For first 5 or 6 years he did tramming; since then coal-getting and holing. Mostly in sitting position or lying on right side.
61	Aug., 1886		George C.			Miner (coal-getter).
62	Dec., 1888	42	Thomas G.	Since he was a ad.	12 months.	Bank work and holing; not much heading.
63	Sept., 1890	27	W. C.	14 or 15 years.		Has to lie on his side holing.

Nature of Symptoms.	Remarks.
Not marked.	Some intolerance of light.
Incipient.	
Oscillations very marked; to and fro and rotatory; increased by turning eyes obliquely.	Suffering from exophthalmic goitre, *vide* "Lancet," 1887, vol. 9, p. 818.
	Abrasion of cornea from piece of coal.
	Worked with protected lights (safety lamps) for 20 years. He returned to the pit not doing any holing or coal-getting. This, he wrote to say, was suitable.
	He gave up "holing" after coming to me, but continued to do other coal-getting: he was much better when last seen.

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
64	Oct., 1889	37	John S.	10 years.	3 months.	Trammer; coal getting few months; has had to do a lot of holing—2 yards under coal. The seam of coal is 7 ft. thick.
65	July, 1880	38	E. A.		2 months.	Holes mostly; thickness of seam 8 ft.
66	Jan., 1890	27	Charles H.	14 years.	4 months	Coal-getting; the position which he demonstrated is just the same as holing, except that he kneels, but he has also done a great deal of holing.
67	Sept., 1890	36	George N.	18 yea	5 or 6 years altogether off and on.	Holing, &c.
68	Oct., 1890	50	J. F. M.	17 years.	2 years; worse last 2 months.	Does holing; middle holing, but he has to go under the coal 5 feet lying down. Has holed entirely for nine years. At his present pit, "every one to his own job"; before then he did mixed work.
69	May, 1889	24	Edward E.			Coal-getter. Holing.
70	April, 1889	40	John A.			Does holing.

Nature of Symptoms.	Remarks.
	He was all right before he began to hole a few months ago ; since then the lights have danced and jumped about.
Slight.	I find the following notes :—He attended first, 18th July. August 12th it is noted—Has continued working in the pit, and says he is better now than he has been for 3 or 4 months, in looking at anything ; the reason being, he says, that he has changed his work. He has done no work on his side, and is working at a 6 feet seam, and can stand upright. When I tell him to put himself in holing position, Nystagmus is at once evident. Sept. 23rd. Wishes to be discharged, says he is wonderfully better, is working upright, does not feel any trouble now. He does not do half an hour's holing altogether in a day.
Slight.	
	This patient was in the medical wards under my colleague, Dr. Dyson, for spasmodic jerking of the head always to the right side. Left sterno-mastoid and upper part of left trapezius rigid (referred to in text, page 71).
	Head quivers.
Latent.	The Nystagmus does not become evident to the usual tests, but he complains of "lamps jumping."

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
71	Jan., 1889	26	Thomas W.	12 years.	4 or 5 years; worse last 12 months.	Since 16 years of age has been a coal-getter. He and his father have had a stall, that is bank work, and most of his work has been holing and working on his side.
72	Feb., 1891	46	George G.	20 years.		Worked at headings; bank work and long wall work. Done a lot of holing, but is not a regular holer.
73	Jan, 1891	33	Wilfrid S.	22 years.	6 or 7 months; for 3 weeks gave up work.	For last six years he has constantly holed; before this worked at bank and occasionally holed.
74	Jan., 1891	34	J. D.	24 years, since age of 10.	4 months.	Coal-getter 16 years. He is a holer, but does his own wood work (spragging). He does not hole in much more than a foot; height of hole 10 inches: seam 32 inches thick.
75	Feb., 1891	51	Charles W.	42 years.		Holing and all sorts, either sitting or lying.
76	Nov., 1890	38	Samuel G.	26 years.	2 or 3 weeks.	Coal-getter; chiefly "undergetting"; this is how he describes holing, his chief work, and takes most of his time.
77	Dec., 1890	39	Thomas O.	20 years.	2 years.	Always been a holer.
78	Sept., 1889	38	Sam. C.		4 months.	Holing.
79	Dec., 1890		Wm. S.			Holer for 20 years.

Nature of Symptoms.	Remarks.
Well-marked. M—3D each eye.	April 9, nearly well; looking to left, never was so bad; still bad looking to right; has worked mostly with left side down and looking to right. Has gone to work in pit, labouring and examining roads, &c.
Not marked.	Came for abrasion of cornea. He made no complaint of Nystagmus, but on inquiry it was found that he had noticed the "lamps jump about." Tremors of head.
Marked Nystagmus	Quivering of eyelids—almost ptosis.
Well-marked.	Has holed mostly with right side down. Before eyes began to be affected he was doing also "clodding," *i.e.*, getting the clod off the top of the coal seam. For this he stood, but his head was placed on one side, chiefly right, and the position of head and eyes was the same or nearly so, as in holing. It was this work that made him bad, he says. This man's case and also "clodding," are referred to in the text, page 45, fig. 8.
Marked.	Came for abrasion of cornea. Nystagmus noticed and inquiries made. Does not now complain, nor has he ever done so much.
Slight; marked on turning eyes up and to the left.	
Marked.	They have had improved lamps last four years.
	Has tried naked lights, but no difference.
	My friend, Dr. Scott writes me in March, 1891, that "he has changed his work; he lays down rails for trams, and though he is working in quite as bad a light, ordinary lamps, his eyes are not so bad." The man also attributes his improvement to his change of work.

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
80	Dec., 1888	45	Hezekiah C.		Suffered more or less for 12 years; worse last 9 months.	Used to get coal and hole; last 9 years he has done getting coal down, mostly high up, 7½ feet; he has to keep his head looking up and also to turn his head on side.
81	Sept., 1890	27	Wm. C.	15 years.		Has to lie on his side holing.
82	June, 1889	34	George S.		2 years or more.	"Ripping, getting roof down," not so much holing lately, but his work is above him, and he has to turn his head and eyes up.
83	Aug., 1890	26	John R.	14 years.	12 months; last 4 months worse.	Coal-getter 6 years. Has done a lot of holing; volunteers that he is a holer.
84	Jan., 1889	24	Joseph E.			Coal-getting and holing; now chiefly shovelling stone and coal.
85	Nov., 1890	29	Wm. B.	Since a lad.	Few weeks.	Coal-getting and holing.
86	Jan., 1883	48	John O.	30 years.	A year or more; worse last 3 months.	Coal-getter. Holing.
87	Nov., 1884	20	Wm. W.	8 years.	4 or 5 months.	All sorts of work; labouring and datal work; for last 6 months has worked as coal-getter; has done "holing" as well as "heading."

Nature of Symptoms.	Remarks.
Rotatory as well as to and fro. More rotatory. (*Vide* remarks).	Lights appear to spin round as he is walking, but if he stands still they stop. Nystagmus much greater looking up and to right than up and to left. He does more work looking up and to right. He takes the left side and this throws his head in this position; his brother takes the right side at work.
Marked symptoms and Nystagmus.	Quivering of eyelids: tremors of head; giddiness and pain in head.
Peculiar; does not occur after depressing head and raising it quickly, but on looking obliquely, especially to left it is evident.	Referred to at length in the text, page 55.
Well marked.	This patient was under my care five years ago, and got very much better. Remained out of pit for 12 months; then returned and has been there 3 years; attending to roads and ponies; 6 months was "buttocking" removing the "sprags" and getting coal down; up to this point he was all right. Then he resumed holing; at the end of 4 months he had to leave the pit and came to me as bad (or worse) as originally. Referred to in the text, under Treatment, p. 77.
Very marked case.	This is the man depicted as holing in the engraving (from photograph) in Transactions of Ophth. Society, 1884; and in this volume, p. 52, fig. 9.
Not a bad case. Nystagmus readily comes on, on looking obliquely.	The Nystagmus developed shortly after working as a coal-getter and holer.

No.	Date.	Age	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
88	Oct., 1890	56	John O.	40 years.	2 years.	Holing and heading; he says in his pit men who do "headings" have also to hole their own coal.
89	Feb., 1891	31	Larrett S.	20 years.	Recent.	He does holing; sometimes kneeling, but can't work unless his head is on one side lowered down; this he volunteers, and it is self-evident.
90	Mar., 1891	24	Thos. K.	11 years.	3 months.	Coal-getting; does middle holing, going 6 feet under coal.
91	April, 1891	34	George J.	21 years.	7 weeks.	Coal-getter 16 years; "holing and cutting has been his work." He learnt coal getting when he was a filler.
92	May, 1891	32	Thomas G.	20 years.	Uncertain.	Coal-getter and holer: mostly holing.
93	April, 1891	39	S. H. H.	3 years.	6 months.	Coal-getter; holing; works mostly under 4 feet.
94	May, 1891	40	S. F.	32 years.	3 or 4 years.	Work has varied, "Stone getting" and blowing it down after the coal was "got." "Coal-getting and holing" again last 2 years; bottom holing 6 to 8 feet under coal.
95	May, 1891	33	John G.	20 years.	4 years; worse lately.	Coal-getting and holing.
96	May, 1882	25	Elijah A.	10 years.		Worked always kneeling or on his side.

Nature of Symptoms.	Remarks.
Not a marked case.	
Movements stop on looking down, and he says "eyes feel comfortable then." Nystagmus answers to usual tests.	Recommended to alter his work to do headings straight forward work, but no "holing." R. — 5 D. cyl. — 1·25 D = $\frac{6}{12}$. L. — cyl. 1·5 D = $\frac{6}{9}$.
Marked oscillations; worse on looking up to right. Works mostly on left side.	He has done a lot of "ripping"—working at the roof; position of head and eyes is just the same as for "clodding" or "top holing."
Distinct oscillations.	Attended with wound of cornea and traumatic cataract. He observes lamps dance, but not sufficiently to necessitate his leaving work at any time. He notices it worse when he has gone into a place where the gas is lighted at night.
Answers to usual tests.	Has been looking after horses for last two weeks. June 2. He tells me he can do this work all right; he is acting as corporal over the trammers, etc.
Giddiness and lights dancing; oscillations hardly noticed.	Mr. Cheesewright, his doctor, had advised his going back to *stone work*, and keeping his head straight, which sound advice I confirmed.
Distinct oscillations.	Tremors of head and neck. Is using candles now.

No.	Date.	Age	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
97	Sept., 1891	51	John R.	42 years.	3 months.	Coal-getter ; holes 6 or 7 feet under coal ; seam is 5 feet thick and "dirt" under it is 1½ yards thick ; so sometimes the working place is 6 feet high.
98	Sept., 1891	27	Henry E.	10 years.	18 months.	Coal-getter 4½ months ; before this "filler" and coal-getting (*vide* under remarks.)
99	Oct., 1891	24	Charles S.	10 years.	4 months, off work now.	Is called a trammer, but he does coal-getting, timbering, etc., (*vide* remarks).
100	Nov., 1890	38	George H.	23 years.	Has had symptoms for the last 12 months, but 4 days before admission had to discontinue work.	Coal-getter. Holer.
101	Mar., 1889	22	Herbert H.	11 years.	1 week.	Has done all kinds of work in pit from driver of ponies. Last 4 years coal-getter and holer. Has holed on both sides.
102	June, 1891	38	Levi R.	Since he was a lad.	8 weeks ; off work 10 days.	Coal-getter ; holes 8 or 9 feet under coal.

Nature of Symptoms.	Remarks.
Very faint oscillations ; "lamps dance" after he has been working ; suffers then also from giddiness and has had to support himself by holding to a prop.	Quivering of head ; tremors felt, also, by hand on head. Volunteers the statement that it must be the "fixing" at his work that occasions his disorder.
Worse after assuming "holing" position, mostly (slightly) looking obliquely to right.	Was a filler for some years, and did occasionally coal-getting. Two years ago, he changed his pit ; was still a filler, and was employed by the day. When he had no tubs to fill he was expected to assist the coal-getters ; and thus he has often worked, getting coal and holing for 3 or 4 hours a day or more. The seam was 6 feet 6 inches and he holed under about 6 feet. For the last 4½ months he has gone back to his old pit, and does nothing but coal-getting. Sometimes a man "is hardly on his feet all day" (lying on his side holing). After work he is very bad, every thing seems to dance, and he appears like a drunken man.
Not well-marked oscillations. Bad headache. Lights dance in and out of pit. Each eye V = 1·25 D = $\frac{6}{6}$.	He has fallen down in the pit, at work, from giddiness. He calls himself a trammer, and though he attends to the "tubs," inquiry discloses that at the pits where he has been employed—a trammer—also gets coal, does timbering, etc. Thus he never passes a day without a good deal of holing. The throwing of his eyes up in "timbering" he finds discomforting, but not so much so as "holing." Has worked with safety lamps and candles ; mostly the former.
Well marked.	When he began to work in a pit he used candles, then for 14 years safety lamps ; for the last 3½ years used candles. With lamps he positively asserts that he had no symptoms. He has done no more holing in this last pit than when using lamps. He with other men drive a heading, and then they get the coal by holing 3 or 4 feet under.
Nystagmus is little marked to usual tests.	Always worked with lamps up to 3 months ago ; since then naked lights (paraffin lamps) called "torches."
Oscillations well marked.	Says himself it is the way he has to put his eyes at work that has made them bad ; demonstrates this for us. Worked with safety lamps 4 years ; before this candles for 9 years ; lamps for 3 years, and candles always before that. Carries head on one side.

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
103	Mar., 1891	37	Thomas S.	21 years.	Uncertain.	Working at heading, clodding and holing, more of this in candle pit.
104	Jan., 1889	31	John C.	22 years.	2½ years, acute quite recently.	Holing and getting the coal down; he has done a great deal of holing.
105	Sept., 1891	52	Henry W.	20 years.	3 months.	Worked as coal-getter the whole time he has been in the pit; "holes" a yard or 4 feet under the coal.
106	Oct., 1891	32	James H.	18 years.	2 years.	Coal-getter, 10 years holing (*vide* remarks).
107	Oct., 1891	24	John W. S.	10 years.	3 weeks; off work 16 days. Suffered from lights dancing 5 or 6 years. Off work for 10days in May.	Coal-getting since age of 16. Middle holing. The seam is 6 feet; or rather there are 2 seams with 20 inches of dirt between them; the middle holing is done for a yard under between these seams. Does his own timbering.

Nature of Symptoms.	Remarks.
Evident to usual tests.	He has never had to leave work for symptoms, and did not seek advice now ; had come with wife who was a patient. Used to use lamps ; lately his time has been thus occupied-- 18 months candles 12 months lamps } 3½ years. 10 months candles He notices the candles go round, and he is suffering as much now as ever he did.
Well marked ; blinking of eyelids.	Worked in same colliery as last patient with naked lights 2 years ; before this safety lamps. Went into candle pit because he was told that lamps made the eyes bad. His work remains the same, but since being in the pit he has got worse ; has had to give up work and seek advice.
Oscillations not decided ; evident only after depressing head and raising it quickly several times, and then looking up obliquely ; or by assuming position for work.	Symptoms first developed after right eye was struck with piece of coal ; since then noticed lights dance, and had to be brought out of the pit 3 times because of giddiness ; "it comes on" after being at work a short time. Seam is 26 inches thick ; but the working place is 1 yard, 3 inches high when the "muck" is taken away.
Well marked oscillations to and fro and rotatory. Eyes ache at his work.	Used candles up to six years ago ; since then safety "lamps ;" improved lamps last two years, but eyes worse notwithstanding this. He mentions an interesting fact as to his work. Holing is not always required ; the coal can be got off with a "bar," but then to get the coal off the top ("roof work"—"ripping") he has to use the pick, swinging it more or less horizontally. He is on his legs, not upright, because the place he works in is 4 feet 9 inches high, and he is 5 feet 2 inches ; he has his head sloping on shoulder, and the position then of head and eyes is very similar, as he says, to that in holing ; just like "bannocking."
Oscillations not very distinct ; answers to usual tests. Left eye lost in infancy. Stump moves.	Always worked with candles. Never with safety lamps. A good many men in his pit (candles) complain of their eyes. (*Vide* p. 129 for special examination of the men at this and neighbouring pit).

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
108	Jan., 1891	23	George T.	8 years.	Few weeks.	Was a driver for 5 years, since then a filler; his height is about 5 feet 3 inches, and the place he works in is 4 feet 6 inches.
109	July, 1890	23	Samuel L.		4 years.	Is a filler.
110	Feb., 1890	18	Frank S.	5 years.	Several months.	A filler; worked at coal-getting sometimes. The workings were 4 feet high and trucks 3 feet; places himself in position of shovelling coal into truck, and this necessitates a good deal of looking obliquely and swinging to and fro. He also gets coal (holing).

111	Oct. 1890	47	John H.		3 or 4 months.	He works at the bottom of the shaft. He is head "hanger-on." The light is good, oil lamps being used, and it is as well illuminated as an ordinary room. Never worked as a miner in the pit.
112	April, 1889	28	Thomas M.			Runs trucks into cage; plenty of light; large paraffin lamps. Never worked at the coal face at all.

Nature of Symptoms.	Remarks.
Not a marked case; relief speedily followed discontinuance of work.	This case was especially inquired into, and it was rendered positive that no day passed without his doing some coal-getting and holing.
Some symptoms; no evident Nystagmus.	Remark applies to this case also that fillers do some coal-getting when they have no corves to fill. This case was also specially investigated.
Peculiar, mostly in left eye; almost "hopping-like" movements.	He admits to getting coal at times, and same remarks as to the first case, apply to this.

SETTERS.

Nystagmus is evident, but not a bad case; the usual symptoms are present.	Investigation showed that the man was obliged to frequently look upwards, trying to see the empty cage come down. At one of his visits at the same time in my room was another man from the same pit, who daily saw this patient at his work, and fully confirmed this (described in detail in the text, p. 60).
	The same remark applies to this case.

ENGINE-

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
113	Dec., 1882	28	John H.		2 years; especially last 3 months.	Attends to engines, and odd work; works in all positions up to 5 feet.

DEPU-

114	Mar., 1891	32	Charles W.	22 years.	9 months.	Deputy; examining stalls, roads, etc., and especially roof. He showed us the position, "head on one side, and eyes directed obliquely."
115	April, 1891	44	J. W.	34 years.	2 years.	Deputy 8 years, previously coal-getter, holer, etc.

* These two cases were found when examining miners working in a Candle-lighted pit. They are

Nature of Symptoms.	Remarks.
Not very severe; and not always noticeable.	This being an unusual case, viz., an engine man suffering from Nystagmus, I endeavoured to again find him and discover the conditions causing his Nystagmus, which my previous note, more than 8 years ago, had left incomplete. I found that the name of his employment was misleading. The place where his engine was situated was 20 feet high and well lighted; he had a lot of work to do, however, attending to the pipes in roads under 5 feet high. He had to lie on his side attending to the pipes, and his work necessitated a lot of turning of his head on one side. He worked with paraffin lamps, but used a "safety lamp" when it was necessary to go to the donkey engine, which was some distance away. Acting on my advice (given in 1882) he has ceased this kind of work; got employment on the pit bank. He still has, however, to go into the pit frequently, and still uses a safety lamp. He travels 1000 yards down an incline to the engine and 500 more to the workings (donkey engine). He does no work now, necessitating such a position as was formerly the case, and though he still uses a safety lamp a good deal, he is perfectly well, and has been for several years. There are no oscillations discoverable by any means, nor indeed has he had any symptoms since shortly after changing his work. (*Vide* p. 59.)

TIES.*

Marked, looking obliquely.	He works in a candle pit, but uses a safety lamp; as deputy he goes into the pit before the men to examine roof and for gas. He is 5 feet 5 inches, and he works under 5 feet or less. Used candles previously to being a deputy (referred to at length in the text page 56).
Fairly marked on looking obliquely.	Previous to acting as deputy, used always candles, except some odd times. Now he uses a safety lamp as other deputy.

mentioned again on page 128, with the other cases comprised in this special examination.

	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
116	Mar., 1891	31	S. H.	25 years since age of 6.	18 months; off work now for 5 weeks; was off work 12 months ago.	Stall-man; does all his own work, holing, getting the coal down, roofing, filling, etc.
117	Mar., 1891	26	F. H.	14 years.	Seven months; off work 14 weeks.	All sorts of work, holing, filling, etc. Calls himself a "loader."
118	Mar., 1891	30	Eli H.	18 years.	6 weeks; left work day of examination.	Stall-man; holing, etc.
119	Mar., 1891	36	John C.	14 years.	5 years; off work 5 weeks.	Stall-man and holing as previous case.
120	Mar., 1891	49	Charles M.	39 years.	2 years; off work 13 weeks.	Stall-man; does holing and all sorts of work; roofing he finds trying, and also showed us the position in which he puts his head and eyes, in order to "throw dirt" with a shovel. He is stooping at this, working under 5 ft., his height being 5 ft. 4 in.
121	Mar., 1891	59	George W.	40 years.	4 years; not worked for 12 weeks.	Stall-man; holing, spragging, roofing, etc.
122	Mar., 1891	49	Edmund E.	37 years.	4 or 5 years; not worked for 6 weeks.	Stall-man; holing, etc.
123	Mar., 1891	32	Arthur S.	21 years.	15 months; never had to leave work.	Stall-man; holing, etc.
124	Mar., 1891	45	Sam. M.	32 years.	16 years on and off; was off work 3 weeks; working now again 1 week.	Stall-man; holing, etc.

* S. H. first came to me, and the cases that follow are those that he was personally acquainted with, who did not present themselves. This investigation is discussed on page 23.

CANDLE-LIGHTED PITS AT C.

Nature of Symptoms.	Remarks.
Right marked. Left very little; to and fro, very little rotatory movements.	Never worked with lamps. R. eye — cyl. 3·5 D = $\frac{6}{12}$ — slight nebula after abrasion from coal in pit. L. eye — 1·25 D = $\frac{6}{6}$.
Well marked Nystagmus.	Always worked with candles, except for 6 months 5 years ago.
Nystagmus not well marked, but symptoms of lights dancing, etc.	Not worked with lamps, always candles. On putting himself into holing position on his side he rises up giddy, and things dance before him.
Marked symptoms, but passing away. He is recovering.	Worked with candles, except for 3 months 2 years ago, and an odd day occasionally, when there was gas in the pit.
Very marked movements. Rotatory especially.	Worked with candles, except 12 months 7 years ago when he used "lamps."
Quivering of eyelids. Oscillations rather jerky, but not very marked.	Never worked with "lamps," except an occasional day when there was gas in the stall.
Very marked in looking obliquely; not so much on depressing head, and quickly raising it.	Never worked with "lamps," except occasionally when there was gas in the pit, and for several years has not used a lamp, except for a day or two.
Well marked, especially up and to right. Works mostly left side down.	Works with candles, but for 18 months worked with lamps; these he discontinued 1½ years ago. He had discontinued using safety lamps fully 3 months before he noticed his eyes affected.
Not marked.	This man is a good example of one entering a room with head tilted back and eyes directed down; bringing them thus more to rest. He has worked by far the greater part of his time with candles 27 or 28 years. At different periods he used safety lamps; the longest time for 3 years.

and was able to get together at short notice for me to examine. There were others known to be afflicted,

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
125	Mar., 1891	24	Charles H.	12 years.	3 years.	Stall-man; holing, etc.
126	Mar., 1891	37	James B.	25 years.	2 weeks; not left work.	Stall-man; holing, etc.
114	Mar., 1891	32	Charles W.	22 years.	9 months.	Deputy; examining stalls, roads, etc., and especially roof. He showed us the position, "head on one side, and eyes directed obliquely."
115	April, 1891	44	J. W.	34 years.	2 years.	Deputy 8 years, previously coal-getter, holer, etc.
127	April, 1891	28	E. H.	11 years.	12 years.	Stall-man and holing.

(B) OF THE WORKERS IN

107	Oct., 1891	24	John W. S.	10 years.	Off work now for 16 days.	Coal-getting; middle holing. Two seams 6 feet together; holing done between these.
128	Oct., 1891	37	Samuel G.	25 years.	3 or 4 months; off work 3 weeks.	Coal-getting; middle holing; roof work. Bottom holing in other pits.
129	Oct., 1891	38	Joe W. (brother to next case).	30 years.	Never away from work.	Coal-getting (as last case).

* John W. S. (107,) was a patient, and the others are miners whom he knew to be suffering from
Surgeon, Sheffield General Infirmary.

Nature of Symptoms.	Remarks.
Fairly marked. Quivering of head.	Worked at first with naked paraffin lamps ; then with safety lamps for 4 years ; then discontinued and worked with candles 15 months.
Marked. Quivering of head.	Candles 15 years ; safety lamps 10 years.
Marked, looking obliquely.	He works in a candle pit, but uses a safety lamp ; as deputy he goes into the pit before the men, to examine roof and for gas. He is 5 feet 5 inches, and he works under 5 feet or less. Used candles previously to being a deputy (referred to at length in the text (page 56). Previously mentioned with the next case, under " Deputies," page 124.
Fairly marked on looking obliquely.	Previous to acting as deputy, used always candles, except some odd times. Now he uses a safety lamp as other deputy.
Marked oscillations; answers to usual tests.	Worked with safety lamps up to 12 months ago. The evidence points, I think, to symptoms beginning just when ceasing to use "lamps." He has been getting worse since using candles

CANDLE-LIGHTED PITS AT D.

Oscillations not very distinct.	Always used candles, never used safety lamps. This case previously mentioned, (No. 107) is here alluded to with others examined from the same pit. He readily got together those that follow whom he knew to be suffering from Nystagmus.
Oscillations fairly distinct. Considerable giddiness at work.	Not used lamps for last 2 years whilst working in this pit ; safety lamps on and off about 6 years ; candles altogether 20 years.
Fairly marked oscillations. No discomforting symptoms.	Worked with candles last 3 years in this pit ; safety lamps for 10 years previously.

Nystagmus, and were got together by him for examination by me, in company with Dr. Rhodes, House

No.	Date.	Age.	Name.	Length of Time in Pit.	Duration of Symptoms.	Kind of Work.
130	Oct., 1891	50	John W. (brother to last case).	30 years.	8 or 9 years, never off work.	Coal-getting as the previous case.
131	Oct., 1891	48	George G.	39 years.	8 or 10 years, never off work.	Coal-getting; holing; middle holing at this pit.
132	Oct., 1891	50	Fred W.	37 years.	Nearly 20 years.	Coal-getting; middle holing in this pit; bottom holing elsewhere.

133	Oct., 1891	25	George S.	11 years.	4 years, never had to cease work.	Coal-getting, middle-holing in this pit; bottom and top holing elsewhere.
134	Oct., 1891	42	Thomas H.	27 years.	5 or 6 years.	Coal-getting and holing; middle-holing in this pit.

CANDLE-LIGHTED PITS AT D.

Nature of Symptoms.	Remarks.
Well marked movements of eyeballs; rotatory and to and fro; oscillations of head.	Worked in this pit with candles for 3 years; for 4 years previous was a fireman at iron works; then with safety lamps for 8 or 10 years; otherwise always with candles.
Rotatory and to and fro oscillations very well marked; other symptoms well marked.	Worked with candles last 3 years in this pit; 10 months before this at another pit with both safety lamps and candles. Has worked more with candles than safety lamps.
Oscillations well marked.	Worked with candles in this pit for last 12 months. Before this with "Davy" and "Geordie" lamp in Durham. Has worked about as much with "candles" as with lamps.

ADJOINING PIT.

Nystagmus well marked.	Worked at this pit 3 years with candles; 2½ years before this with safety lamps; then here for 4 years; worked mostly with candles, with lamps was doing more holing (top holing).
Well marked oscillations.	Worked in this pit with candles 1 year, and neighbouring pit 2 years with candles; before this safety lamps for 7 years. He has used candles 20 years, safety lamps 7 years. Is decided in saying he is no better with candles.

DR. DRANSART'S LETTER.

THE "BRITISH MEDICAL JOURNAL," August 8th, 1891.

MINERS' NYSTAGMUS.

SIR,—I have received the "*British Medical Journal*" of July 11th 1891. I have read with pleasure Simeon Snell's paper on Miners' Nystagmus, and especially his very interesting note, Nystagmus in a compositor. The last case is a very important one. I will publish it in the "*Journal d'Oculistique du Nord de la France*," where I must publish my paper on Miners' Nystagmus read at the Paris Congress. I completely agree with the views Simeon Snell has expressed as to the upward, more or less oblique, manner a hewer of coal throws his eyes when at work, and believe with Snell that the Miners' Nystagmus is similar to writers' cramp, that is to say, that Miners' Nystagmus is a myopathic disease.

Having observed many cases of Nystagmus amongst miners working with naked lights, I cannot accept the theory of safety lamps as a prime cause. I have read with pleasure in Snell's paper that Nieden has also found Nystagmus in pits where the ordinary lamps were used, and he has stated as the first prime cause of this affection the peculiar kind of work which the hewers had to do in holing the coal in a stretched position of the body, head and eyes.

Thus Nieden in Germany, Snell in England, and I in France, who are known to be much acquainted with Miners' Nystagmus—we have all three the same statements on this interesting disease.

I think it would be useful to ascertain the geography of Miners' Nystagmus. If we are not mistaken, the disease will be found rare and light (embryonic or latent) in the pits where the seams are high; on the contrary, it will be found frequent and grievous in the pits where the seams are low. I think it will be so whatever be the mode of illumination. Nevertheless, I believe that the safety lamps with the same conditions, increase the number and the gravity of the Nystagmus. The geographical information I have gathered in France is corroborative of our statements.

I am, etc.,

Institut Ophtalmique, Somain, Nord, France. DR. DRANSART.

CASE OF NYSTAGMUS IN A COMPOSITOR.*

By Simeon Snell.

Harry K —, æt. 21, applied to me on October 17th, 1890, at the Sheffield General Infirmary, complaining of objects dancing before his eyes. He was a compositor, and had just completed his apprenticeship, and for the last six months he had been at work on night duty from 7 p.m. to 3 a.m. He was engaged on the staff of a daily paper of large circulation.

Symptoms at first developed two days before his attendance. He had been well apparently on leaving the printing office at three o'clock in the morning and went to bed as usual, but on rising at twelve noon he found his eyes were "all of a dazzling sensation," objects seemed to be moving up and down. He did not feel ill, no pain in head nor sickness.

He had had occasional attacks of vertigo and fainting and he says that for a month before his eyes began as mentioned, he had had two or three faints at the office, as he thought from the room being hot. His health had not been good.

On examination Nystagmus was found to be present, the oscillations being vertical and of a peculiar jumping-up-and-down character, with some quivering also of eyelids.

He was carefully examined by my colleague, Dr. Cocking, assistant physician, and Mr. Wightman, house surgeon, as well as myself, for any central, or indeed any general condition with which this sudden onset of Nystagmus could be associated, without discovering anything abnormal. There was no indication of plumbism. He was weakly, and his work recently had been at night and heavier than usual, otherwise than the Nystagmus, the eyes were normal V. = $\frac{6}{6}$ in each unaided; there was weak H. Bromide of potassium in ten-grain doses was prescribed.

October 21st.—He is better; jumping of eyeballs is less.

28th.—Still further improvement noted.

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* Reprinted from the Transactions of the Ophthalmological Society, 1891, p. 102.

31st.—On the 29th he says, after supper he was seized with vomiting, and his eyes have moved somewhat more since. He complains of his hands having felt cold and cramped. He was again examined for me by Dr. Cocking. He reported as he had done before; there was no evidence of the sickness being otherwise than gastric in origin from error in diet.

The Nystagmus gradually disappeared, but rest was enforced, and he did not recommence his work until December 30th.

This case is to me one of considerable interest, especially in connection with the Nystagmus met with among miners. My views on the causation of this affection among the workers in coal mines are, I believe, well known. In my opinion the chief and prime cause is to be found in the constrained position the eyes are compelled to assume by the miner at his work, chiefly in "holing" the coal. These views are set forth before this Society in a paper published in the "Transactions" in 1884. My recent and more extended observations will be recorded in the "British Medical Journal."* In this paper two cases of Nystagmus are described as occurring in men, who, though working underground, were not practical colliers. They had not used a pick or worked at the coal face. Their occupation was at the pit bottom, and consisted in dispatching the tubs filled with coal to the surface—as a full tub went up the shaft an empty one came down—they worked in an excellent light, and were called "onsetters." In dispatching the tubs they would look up the shaft, watching the ascent of the full one and the descent of the empty. In this way, standing as they did with their heads on one side and their eyes directed upwards and necessarily obliquely, was, I believe, the Nystagmus occasioned. In the paper alluded to the cases have been described at length and the subject entered into more fully than is necessary for our purpose now.

To return to our compositor. In the absence of any definite lesion with which the Nystagmus could be associated, and observing its resemblance to Miners' Nystagmus with which quivering of the eyelids is also seen, I determined to investigate his manner of work to ascertain if his disorder could in this way find an explanation. In company with

* July 11th, 1891 (vol. ii, p. 61).

Mr. Wightman, I paid a visit to the youth at his work one evening about ten o'clock; the large room in which the type was set up for a large daily paper was well lighted, and there were many men at work.

The youth worked standing, picking out the small letters from a font in front of him; the capitals were on a higher level, and above that again was placed the manuscript from which he was setting up the type. He picked up the letters, reaching forwards for the capitals, with his right hand, placing them together in a "composing-stick" in the left; during this process he constantly raised his eyes to the manuscript. It was the latter point that was of special interest. Careful watching for some time convinced us that when he looked up to the manuscript he turned his eyes upwards but did not at the same time raise his head. Now anyone trying this, even for a short time, will find how tiring and uncomfortable it is. The upper elevators of the eyeball are not only unduly working, but a strain is also being put on the elevators of the eyelids. In this way the chronic fatigue and muscular disability of both kinds of elevators has been occasioned, and the vertical Nystagmus and the twitching of the eyelids are accounted for.

On watching the older and more experienced workmen, it was found that in looking up at the "copy" they did raise the head at the same time as they turned their gaze upwards. The patient readily allowed that he was accustomed to work in the manner indicated. He was desired in future to elevate the head at the same time that he directed his eyes up to the manuscript.

He has recovered from the Nystagmus, and pursues his composing now in the manner advised with comfort to his eyes.

Dr. Hill Griffith, of Manchester, was visiting me a few weeks since. I brought the youth under his notice. He was, of course, then free from the Nystagmus, but Dr. Griffith accompanied me to the printing office to see him engaged at his work, and he is able to agree with me as to the description given as to the manner in which the patient had been in the habit of "looking" at his occupation.

It should be added that up to six months before suffering from Nystagmus he had been doing work less irksome. He set up large type, and after doing a line or so, went off to another place; thus there

were intervals at his work. For the six months before coming to me he had worked as described, standing at one frame throughout the night.

A further interesting development of the case has taken place. He is now incapacitated from following his employment by "compositors' cramp." He first noticed a sensation of numbness and cramp in the right thumb, and in less degree in the first two fingers on June 16th. The next two nights he could only very partially do his work, and on the 20th had to relinquish the attempt. He felt it not only impossible to pick up the type, but the effort was painful. The end of thumb and fingers were also tender.

It may be said that he appears susceptible to muscular disabilities.

This case seems to take us further towards recognizing muscular strain as occasioning what may be called Occupation Nystagmus. From the hewers of coal, and other workers in the mine, we have come to the "on-setters" engaged at the pit bottom in a good light, and now is the case of this compositor. The recognition of writers' cramp or Scriveners' palsy was the first of its class. Since then it has been followed by the observation of similar conditions resulting from other occupations. It is not impossible that such a case as here described in a compositor may lead to the recognition of Nystagmus as occasionally being noticed in this or other occupations by other observers.

(July 3rd, 1891.)

EXAMINATION OF MINERS NEAR WAKEFIELD WITH DR. SMITH,* IN JULY, 1891.

1. William P., aged 60, works at E—— pit; is a deputy, and has been so for twenty years; uses a Davy lamp. Has been a "coal-getter" since the age of 15; not used candles.

The seam of coal is 28 inches to 30 inches high; the working places are the same height; the roof is rock and the floor is hard. There is no "holing"; the men sit on "crockets," which stand about 4 inches high behind and 2 inches in front. He has seen "holing" done, but the work in this pit is not like it. The men "bare," as they call it, the coal, *i.e.*, they clear away under the coal with the pick for about a foot; in his seam this is done by getting away the rubbish, and then the coal is got down with the pick. This "bareing" under the coal will not be more than about 6 inches high. The position of the head is sloping, but the direction of the eyes will be a good deal downwards towards the floor.

2. Dennis P., aged 50; works at H—— B——. Worked in a coal pit all his life; uses lamps (safety); he is a dataler; has been a coal-getter. The seam is 26 inches high; old hard seam; the roof is hard. There are 65 to 70 men employed as coal-getters; 20 boys; 4 day men and 7 "rippers"—makers of the road higher. They "bare" the coal under for about a foot—the sprags required will be 6 inches to 8 inches high. Some place their lamps between their legs and some behind them. He placed himself in the holing position. No complaint of eye-sight. Very good lamps (Clanny or Mueseler). Worked in this pit 14 or 15 years; worked with candles for 10 years, but not for the last 14 or 15 years.

3. Joe W., aged 50; works at C—— pit. The men employed will be 81 as coal-getters, and 9 as datal men, and 19 boys. He is a coal-getter; he has been engaged in a pit for 41 years, and for 30 years has

* My visit to this district is described at page 65. Notes are now given of the cases examined.

been a coal-getter; always worked in this district—thin seam; the seam is the thickest in these parts, being about 36 inches. They undermine the coal, getting away the rubbish, the "bareing" being about 6 inches high. Hard roof. Very little complaint among the men about their eyes; he has heard men say that the lights danced. Safety lamps (Clanny) give a good light. He made no complaint.

4. William W., aged 34; C—— pit; coal-getter; men do not complain of their eyes.

5. Rowland P., aged 50; works at P—— pit; worked in coal mines more than 40 years; been a coal-getter for 25 years; uses safety lamps —Clanny. The seam is 32 inches or 33 inches thick; he sits on a crocket at his work. 50 men are employed as coal-getters, and there are 50 boys. Has had the glass lamps (Clanny), for 3 years before this—Davy lamps; worked with candles many years ago. *Nystagmus* is present on looking in an oblique direction; mostly to right. No symptoms. Never away from work on account of his eyes. Six years ago he worked at H—— B——; seam 24 inches high; position assumed at work just the same as holing; giddiness more then, and it would seem that his eyes began then too.

6. William W., aged 46; coal-getter; P—— pit; same pit as last case; mentions lamps dancing, but there is no Nystagmus.

7. George L., aged 34; worked in pit 24 years; trammer 7 years; coal-getting 17 years. Works at a pit at C—— W——; been in several pits; one with a 5 feet seam at D——; he was a trammer then. Now he is working a seam 24 inches thick; the floor is soft. He *works in "holing position"* for 1½ yards. Suffered for 2½ years more or less—he has been decidedly worse since he worked in holing position, and has been away from work for 14 weeks. When he keeps his head straight he is all right. He has worked on a crocket like the other men, and from his experience it is not nearly as trying as the holing position. He has used candles; it began when he was employing safety lamps, and a year ago he went to a candle pit at L——. Here the seam was a yard thick; he holed in a short distance, he did not go underneath the coal, and he says he kept his head more upright—if he put it on one side it was as bad as with the lamps. He got no better.

No work like "heading" is done in these pits.

8. Alfred W., aged 36 years; works at E——; Clanny lamps; worked in pit 26 years. He makes no complaint.

9. Edward F., aged 40; works at T—— C——; worked in pit for 31 years; coal-getter 22 years; uses a Geordie lamp, glass inside and gauze outside. Employed in this pit are 79 coal-getters; 41 boys; and about 20 day men. He knows of no complaint of men as to their eyes; never heard of any saying that the lights danced about. Used the Geordie lamp for 2 years; before this the Clanny for 12 months; and again before this the Davy. The seam is 26 inches thick, and he works on a crocket.

Other cases examined were the following :—

10. F. P., aged 24; E—— pit; coal-getter; Clanny lamps.

11. Thomas W., aged 45; C—— pit; Clanny lamps. There is some Nystagmus; oscillations on looking obliquely; never off work; no symptoms. Holes 4 inches high on a crocket; does not work on his side but slopes himself very much to left; formerly worked in 24 inch seam.

12. James B., aged 23; lamps; E—— pit.

13. Charles H., aged 30; lamps; C—— pit; Nyctalopia.

14. William R., aged 26; lamps; T—— pit; used a Geordie lamp for 12 months, before that a Clanny.

15. S. P., aged 27; lamps; E—— pit.

16. Thomas W., aged 35; coal-getter; lamps; Nystagmus slight, but no complaint of lights dancing or other symptoms at any time.

17. L. P., aged 30; E—— pit; worked with Davy for 19 years, and Clanny for 6 months; no complaint.

18. William W., aged 33; C—— pit; Clanny lamp; no complaint.

19. Arthur L., aged 24; P—— pit; Clanny lamp; no complaint.

20. George W., aged 34; P—— pit; Clanny lamp.

21. Ephraim I., aged 26; C—— pit; lamps; no complaint.

22. A. P., aged 26; lamps; P—— pit; no complaint.

23. James E., aged 26; lamps; P—— pit; no complaint.

24. Davy L., aged 41; worked in pit since the age of 8; no complaint; worked with candles 4 years ago, then for 5 years before that with lamps, now for 3 months with candles.

25. G. L. M., aged 34; worked in pit for 14 years; used lamps;

H—— B—— pit; he was off work for a week in the middle of last year because of the lights dancing; he was then working at a colliery in the Barnsley bed, seam 4 feet thick. Then he did work under the coal. He stayed at this pit for a year and nine months; before this he had worked lying on his side near Bradford. The seam there was only 15 inches, and the coal could not be got otherwise. Before he did this work, lying on his side, he was all right. Now that he has come to this district he is better. The lamps at W—— were spirit; at C——, oil, Clanny, the same as in use at H—— B——.

26 and 27. Besides those mentioned there were two others who were not closely examined, but were in the room, and stated that their eyes were all right.

NYSTAGMUS IN A MINER WORKING WITH NAKED OIL LAMP, ETC.

The following case which has come before me since the text of this volume was printed possesses features which make it worth while to record it here. It illustrates coal mining of varying kinds both in this country and in America.

Henry K., aged 40, was sent to me by my friend Mr. Makeig Jones, of Wath, on December 29th, 1891. The man complained of not being able to see to do his work, and had, a week before, been obliged to leave the pit. It is interesting to note, that he complained less of the lights dancing than he did of his inability to see properly, though on inquiry it was readily elicited that he was troubled with objects apparently moving before him. This was soon explained, because though Nystagmus was present in a very marked degree, the oscillations were unusually rapid, and the excursions of the eyeballs were in a much smaller field than is generally the case. The movements might indeed be likened to fine tremors, whereas those most frequently met with in Nystagmus would in comparison be regarded as coarse tremors. The oscillations were so quick that as Dr. Wilson (Assistant House Surgeon) held his watch to give me the time, I found that in less than half a minute I had counted over 150, and gave up as impossible making a really accurate estimate. The ocular movements were noticeable on his looking directly forwards, but particularly so on directing the gaze upwards, and were even more so when turned obliquely up and to the left. His work had mostly been done with the right side downwards. Held directly in front of him he was unable to read the large letters of Jaeger's types, nor could he distinguish $\frac{15}{200}$; on turning the gaze downwards the oscillations abated, and he immediately told the time by my watch. It should be added that the movements of the eyeballs were so very rapid that it was difficult to separate them into the usual characters of rotatory, to and fro, etc.

He has worked in coal mines for 32 years; first he had been employed as a trapper; then as a boy assisting a deputy; and in succession pony driver, trammer, and then at the coal face as a coal-getter. He was aged

20 when he commenced work as a coal-getter, and he has been occupied in this kind of work ever since. As a trapper he used candles, but besides this he had employed safety lamps up to his going to America in 1884. The safety lamp used was a Geordie except at one pit where he worked for six months with a Mueseler type of safety lamp burning colzaline (mineral oil). He was engaged in four different coal mines, but they were all working the same seam of coal—the Barnsley bed—six feet thick. At one of these mines he worked after his return from America with naked lights, but in a different seam. The work in all these pits was just the same; in all holing was done, though the amount of this kind of work was variable. He did his own timbering.

He went to America in 1884. He was employed there by the Brazil Block Coal Company in three collieries situated close to each other, in which the seam of coal was also the same. The roof, he says, was generally level, but the floor frequently rose so that the coal was in "basins" and was five feet thick at one place and perhaps only two feet at another. Here the miners worked with naked oil lamps stuck in their hats. The oil used was called lard oil, and half a pint would last from seven in the morning till five in the evening. Sometimes it was easy mining and the coal was knocked down with wedges and a sledge hammer if there was a "slip" (crack) in it, and if not, it was blown down by explosives. Generally he could stand upright at work, but often he had to kneel. The coal was generally worked by blasting after boring by machines, and it was only for about three months out of the six years that he was in America, that he was engaged in doing work with the wedge, and this was the only period that the work performed at all approached "holing." At this employment he went on his knees and used the pick to clear the seam at the bottom, but not far in. The men set their own timber, but it was so plentiful that no trouble was taken to withdraw it.

He returned to England in December, 1890. In the January following he obtained employment at a mine in which safety lamps (Clanny) were used, but he only worked there for about a month. Then he went into a pit where candles were used. It was one of the mines he had been engaged in before going to America, and at the part of the pit he worked at then safety lamps were employed. But the seam of coal at which he was now

engaged was different. The former one was the Barnsley seam and was six feet thick; the present one was only three feet and about two inches thick. This is not fiery, so naked lights are used. Tallow candles are sold to the men at the mine, sixteen to the lb., but they prefer, it seems, to purchase their own candles, which are paraffin, twenty to the lb., and it is asserted they give a steadier and better light. It is very hard mining in this pit, the worst he has had. There is shale about an inch thick a foot from the bottom, and there the "holing" (middle) is done. Every yard of coal is "holed." He works on a stool and lies with his body on his thigh. He "holes" in from two to three feet and reaches the end with his pick without drawing his body under the coal.

The lamp which he used in America, and which he has given to me, is superior in the light it affords to a candle. It is interesting therefore to note, that after using only half a pound of candles, he always employed this lamp stuck in his hat, as he had been in the habit of employing it in America.

When he went to work in this mine he says his eyes were as well as ever they were in his life. It was after being engaged at the work spoken of for about five or six months that he noticed his eyes wrong at first. On December 24th he had to relinquish his employment as he could not continue it.

Before leaving England for America, he says, he had noticed objects dancing before him, but he never discontinued work in consequence. In America, with different work, it will have been noticed that he improved, and on returning to England his eyes were perfectly good. A change of work to a prejudicial one, under the same circumstances (as regards the illumination) as in America, brought about the severe condition for which he came under treatment.

The immediate effect of cessation of work on vision was most marked. A week after coming to me he could read $\frac{20}{100}$: another week later vision had improved to $\frac{20}{70}$. The lessened frequency of the oscillations was even more decided.

He has been a heavy smoker (4oz. a week) and possibly there is in addition to the Nystagmus some amblyopia. There is, however, no scotoma for red or green.